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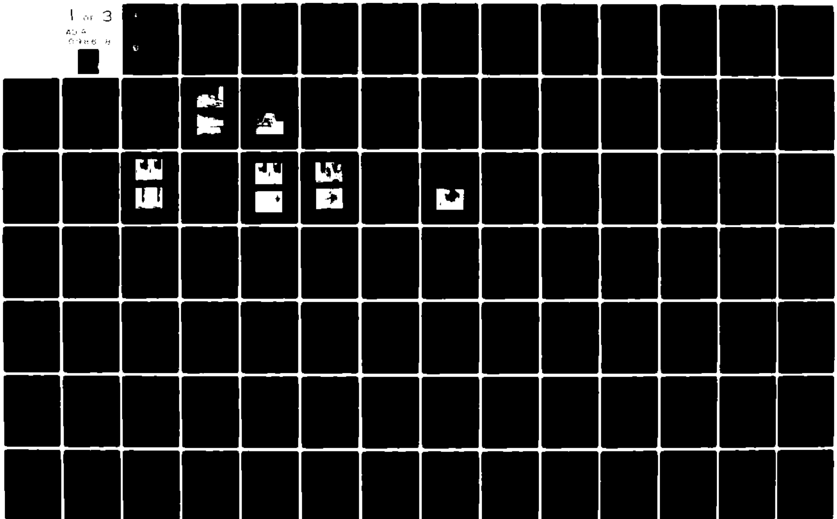

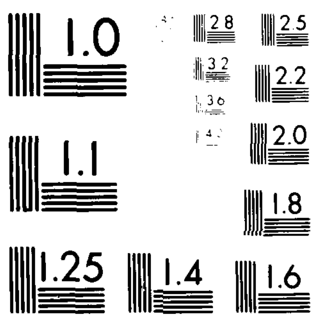

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TECHNICAL REPORT TR-RS-CR-81-1

LOW COST HIGH VOLUME RADIOGRAPHIC INSPECTION

SYSTEMS ENGINEERING DIRECTORATE
MANUFACTURING TECHNOLOGY DIVISION
US ARMY MISSILE LABORATORY

JANUARY, 1981

U.S. ARMY MISSILE COMMAND
Redstone Arsenal, Alabama 35809

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Helen J. Abplanalp
Jon M. Tanke

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This document describes a prototype non-film radiographic inspection system designed to perform rapid assembly configuration verification of large complex assemblies. The system includes capabilities for: (1) real time X-ray radiography, (2) digital image enhancement, (3) remote part positioning and manipulation and (4) computer aided inspection. The advantages and limitations of each of these capabilities are discussed. A cost/benefit analysis is also included.

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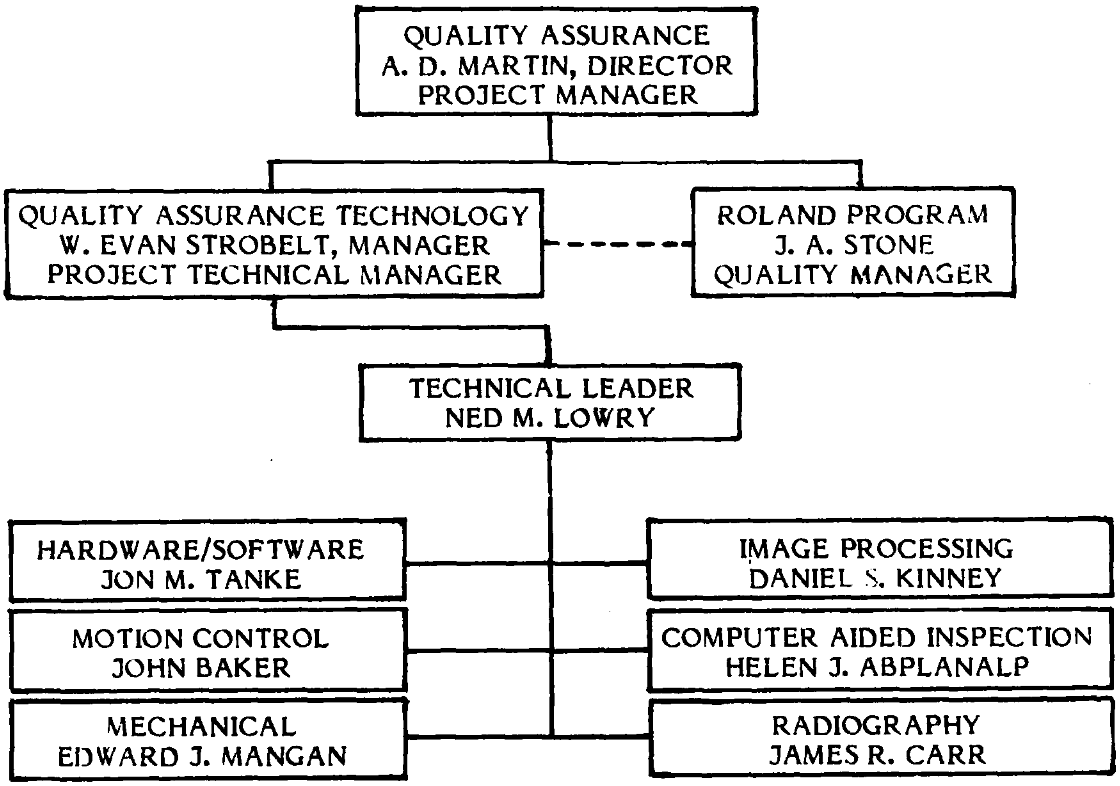
FOREWARD

This project was made possible through initial and continuing support of Boeing Aerospace Co. management and through the dedicated efforts of its engineers and technicians. Those persons who were directly involved in the project are shown below. There are also many others who also contributed invaluably to the success of the project.



PROJECT ORGANIZATION

SUMMARY

A prototype system has been assembled to establish the feasibility of performing assembly verification using advanced non-film radiographic techniques. The equipment has been configured to provide real time X-ray radiography, digital image enhancement, remote part positioning, and computer-aided inspection.

Real time X-ray techniques have been applied to an inert ROLAND missile which was assembled for this purpose. When viewing parts of relatively uniform thickness, an X-ray image intensifier coupled to a vidicon camera provides adequate sensitivity for configuration inspection applications. However, when a part has very thick areas next to very thin areas, the high energies required to inspect the thick areas allow sufficient energy levels in the thin areas to blind or damage some vidicon cameras. Applications of this nature require use of a different camera system, such as a fluorescent screen and an isocon camera.

Provisions for remote control of part motion are necessary to take full advantage of real time radiography. A prototype part manipulation table and control unit has been assembled to perform remote part positioning either manually or by a computer.

When higher resolution than provided by the real time system is required, the use of image processing is indicated to increase the image contrast and detail sharpness. A broad range of digital image processing techniques has been examined. Techniques found advantageous were video frame averaging, contrast modification, gray level slicing, Laplacian and gradient edge enhancement, and pseudocolor. Useful evaluation aids included split screen for comparison of two images and profile and histogram graphics. The evaluation has produced an optimized image processing sequence for each critical inspection area on the ROLAND missile.

A computer-aided inspection system has been developed to perform parts positioning, image enhancement sequences, and records storage and retrieval. The final acceptance decisions are made by the operator. Cost/benefit studies indicate that high volume manufacturing applications could benefit from computer-aided inspection procedures as well as image processing techniques.

Image storage techniques have been evaluated with respect to cost, quality, and ease of retrieval. High density digital magnetic tape is the preferred choice. However, for applications not requiring a computer for image processing or records management, video tape provides an adequate image storage medium.

As a result of this project it has been concluded that real time X-ray should be implemented into all inspection facilities performing radiographic assembly verification (e.g., ROLAND). In addition, it has been determined that development of systems with higher resolution and sensitivities would make possible wider application of this technique, resulting in the replacement of most film-based radiography.

1.0 INTRODUCTION

Many products, such as the ROLAND missile, must pass an X-ray inspection prior to release from the manufacturer. This is to assure that all internal parts are present and assembled correctly. Without verification of internal structure by radiographic inspection, a defective missile could be deployed. Such a missile could malfunction and potentially cause catastrophic failure.

Radiographic examination of critical low-rate-production components and assemblies traditionally has made use of film processing methodology. The use of film-based methods is prohibitive for high rate production due to the high labor and film costs and excessive flow time. The development of a non-film radiographic inspection method was clearly necessary to reduce the costs of assembly verification of high volume products.

Fluoroscopy offers the best potential to replace conventional film radiography. Applications of real time systems have been limited because the X-ray image is generally of lower quality than film. Low sensitivity has been a major drawback in applications requiring detection of very small flaws, but when examination requirements are primarily related to hardware configuration, spatial resolution is of lesser importance.

The purpose of the project has been to develop and demonstrate a prototype non-film radiographic method for verifying the configuration of large, complex parts. The ROLAND missile final assembly inspection was chosen as the target application for this project, although the techniques developed could be used for inspecting the internal configuration of any complex missile or part.

Recent improvements in fluoroscopic screens, electro-optical imaging devices and image processing technology have substantially reduced the gap between film and direct-viewing systems. The improved technology has made it feasible to develop a non-film system for examination of ROLAND hardware which will meet inspection requirements at a significantly lower cost, ultimately resulting in greater reliability due to the capability for more complete inspection coverage.

A real time fluoroscopic X-ray inspection system has been developed to meet the goals of reduced cost and flow time. The concept of real time X-ray is shown in Figure 1.0-1. The X-rays which pass through the test part fall on a fluoroscopic screen instead of a photosensitive X-ray film. The fluoroscopic screen converts the X-rays to visible light, and a camera transmits the image to a remote monitor. Remote control of part motion allows the operator to inspect the part at every angle and position. The real time image may be digitized so that image enhancement techniques can be performed upon it. The digitized image may be saved on a magnetic tape or disc associated with a computer system. Automatic control of parts positioning and image processing allows a computer-aided inspection scheme to be used. With this system, techniques have been developed that could be applied to final assembly verification of the ROLAND missile.

It is estimated that a cost reduction of 8:1 and flow time reduction of 5:1 could be achieved through the implementation of non-film methods. For the ROLAND missile this would result in a savings of over $1.1 million based on a production of 10,000 units.

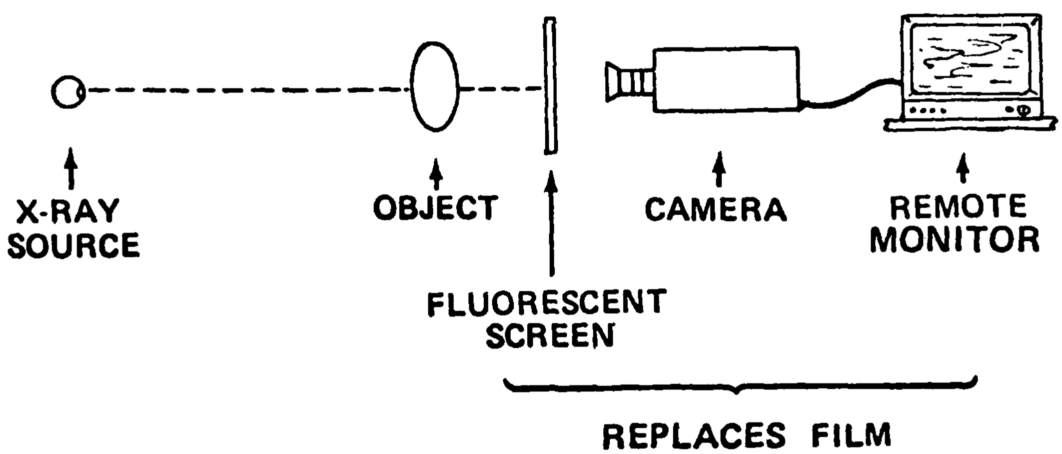


FIGURE 1.0.1 REAL TIME RADIOGRAPHY - CONCEPT

2.0 SCOPE OF WORK

The scope of this project covers the evaluation of three areas: real time X-ray, image processing, and computer-aided inspection. The real time X-ray system includes a fluoroscopic image intensifier tube, an antimony trisulfide vidicon camera, a TV monitor, and a remotely-controlled part manipulation table. Digital image processing was executed under control of a computer system, and was performed on digitized images. The computer-aided inspection system controls routine procedures, such as part positioning, image processing sequences, and storage and retrieval of records and images. Computerized decision-making was not investigated and did not fall within the scope of this project.

The prototype inspection system was applied to assembly verification of the ROLAND missile propulsion unit. Since this inspection was the target application for the project, care was taken to assure that all ROLAND radiographic inspection requirements could be met.

The major program milestones and their interrelationships are diagrammed in Figure 2.0-1. After the real time imaging system was assembled, part manipulation and image processing systems were added. A prototype computer-aided evaluating inspection system was then developed. Optimization of the real-time images of image processing techniques, and determination of the best testing procedure for the computer-aided inspection were accomplished. It was then possible to perform a cost/benefit analysis for these systems. An industry demonstration was given on September 17 and 18, 1980.

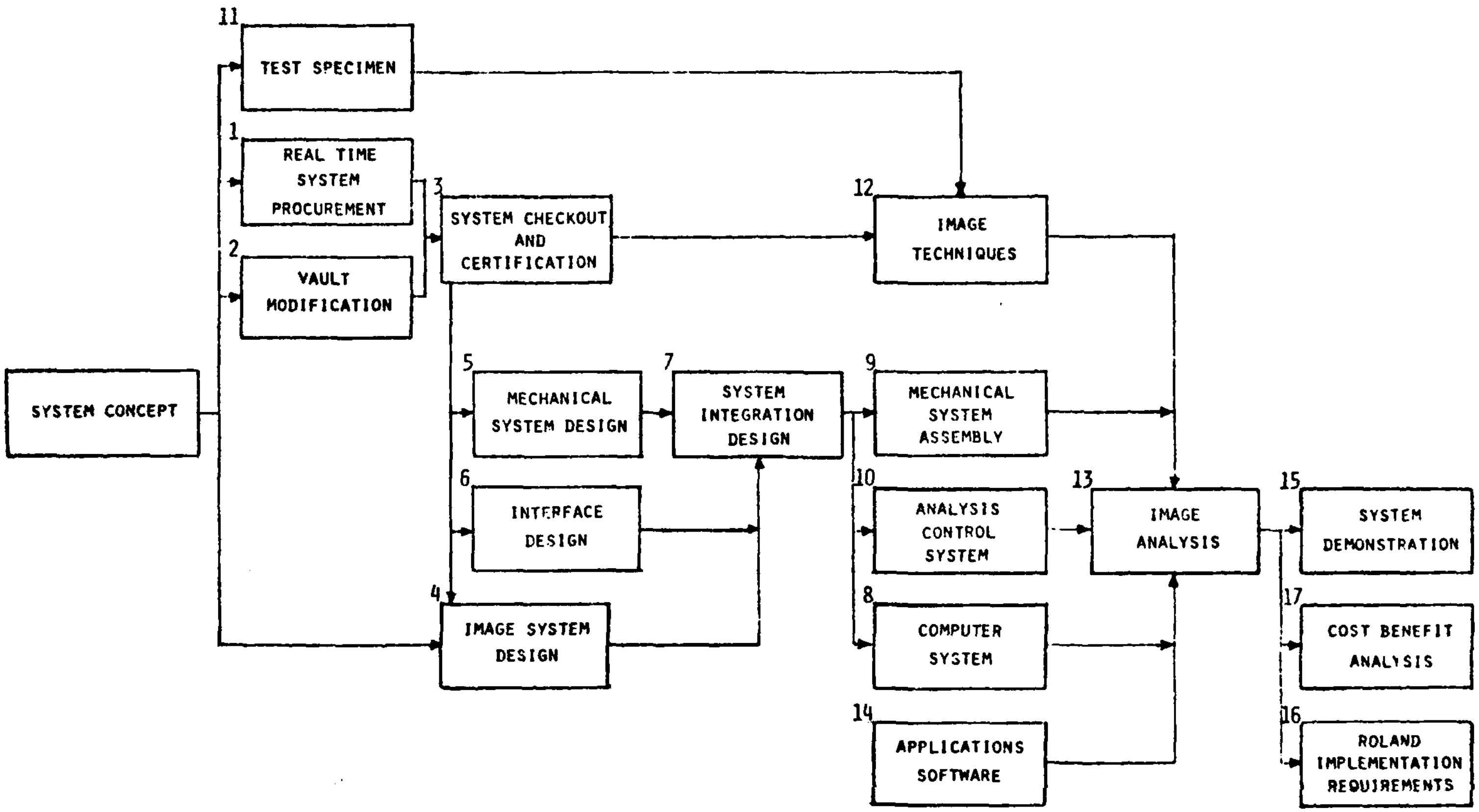


FIGURE 2.0-1 MAJOR PROGRAM MILESTONES

3.0 EQUIPMENT DESCRIPTION

To assure a high probability of success, the equipment selected was that which met the highest possible standards consistent with return on investment rationale of a 2 year payback. Figure 3.0-1 shows a block diagram of the overall system. The individual items are described below:

1. X-Ray Generator, Model MCN321, Philips Electronic Instruments, Inc.
2. X-Ray-to-Visible Light Converter and Intensifier, Dynascope Models 22D20R and 17D20, Machlett Laboratories, Inc.
3. Video Camera, Model LSV-1, Sierra Scientific Corp.
4. Video Monitor, Model SNA-24R, CONRAC Corp.
5. Image Processor, Model 70/E, Stanford Technology Corp.
6. Image Processor, Computer Interface, Boeing Aerospace Co.
7. Computer System-Model 550, Prime Computer Inc.
8. Parts Control-Computer Interface, Boeing Aerospace Co.
9. Parts Control, Boeing Aerospace Co.

A ROLAND missile booster and sustainer motor section was assembled with inert grains for use during the project. The inert grains were machined from solid polyvinyl chloride (PVC) rods to simulate actual grains in dimensional stability and optical density and uniformity. However, these inert grains were not coated to simulate an inhibitor as this would have been cost prohibitive and that requirement can be met when the system is implemented.

3.1 MECHANICAL EQUIPMENT

The real time X-ray mechanical equipment has been assembled to permit a complete examination of the ROLAND missile. The part manipulation table (Figure 3.1-1) supports the missile at each end. The table was constructed with three degrees of freedom: longitudinal, transverse, and rotational. The longitudinal and transverse movements permit a full scan of the missile over the total length and width while it is continuously rotated. A remotely controlled lead shield (Figure 3.1-2) permits selective examination of small areas and reduces scattered

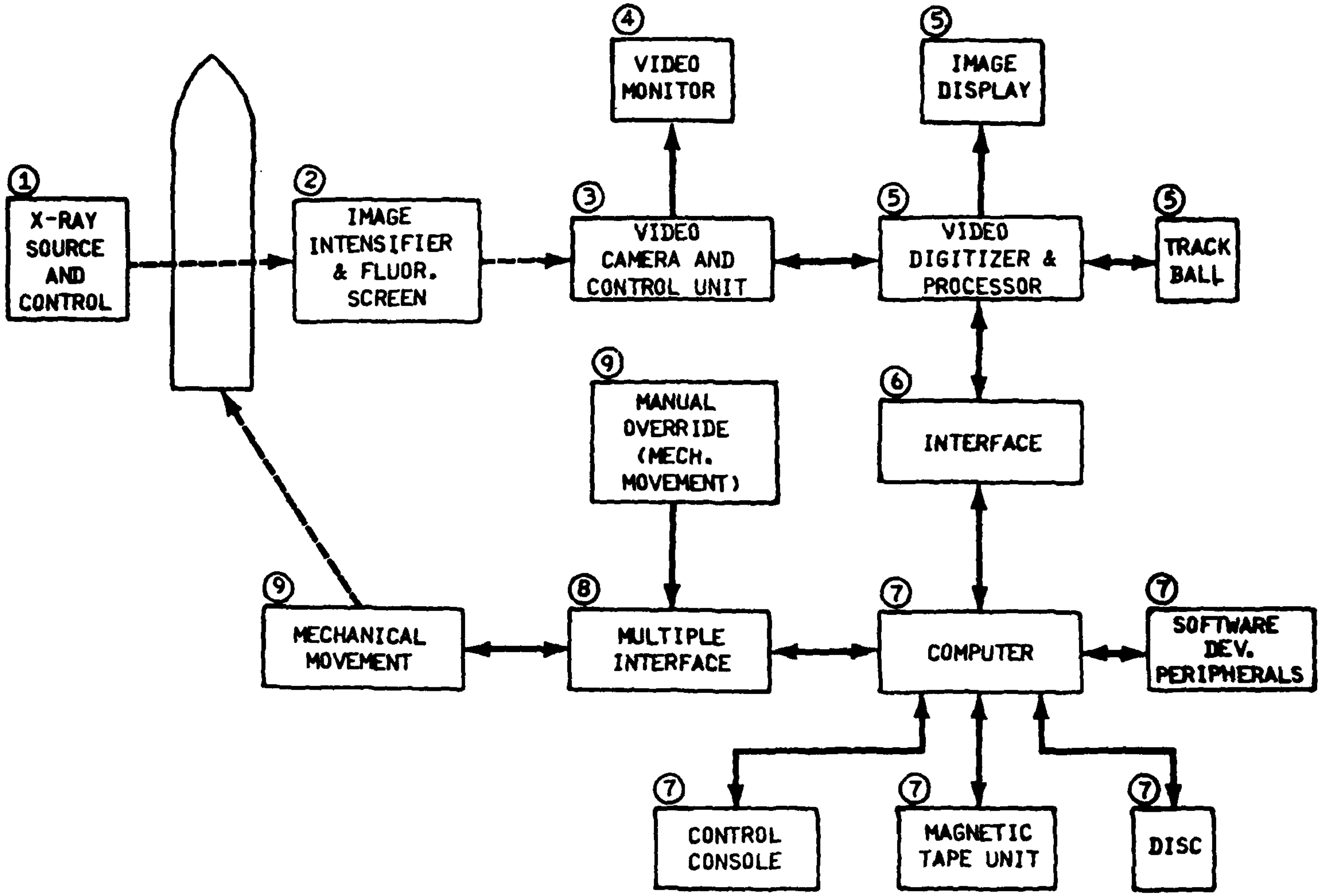


FIGURE 3.0-1 HIGH VOLUME RADIOGRAPHIC INSPECTION SYSTEM

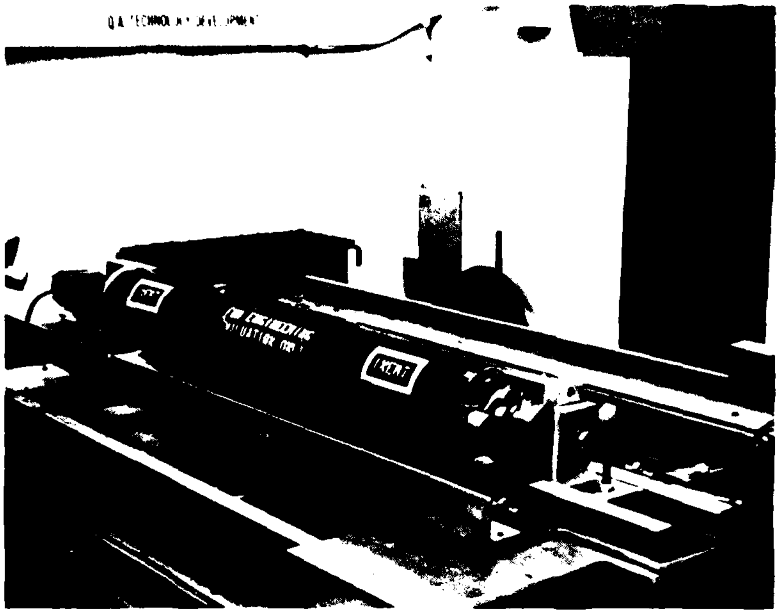


FIGURE 3.1-1 PART MANIPULATION TABLE

FIGURE 3.1-2 LEAD SHIELDING

X-rays, improving sensitivity. The X-ray tube height can be adjusted to achieve a source-to-fluorescent-screen distance of up to 210 cm (Figure 3.1-3). All movements are electrically controlled and can be remotely adjusted.

The prototype system enables the missile to be manipulated, allowing evaluation of all of the defined inspection locations. Motor drive systems were installed to allow automatic positioning of the missile simulating actual production testing operations. Radiography was performed vertically in the prototype system to comply with safety regulations for the particular facility. Modification of the mechanical system will be accomplished during the production implementation to accommodate horizontal radiography.

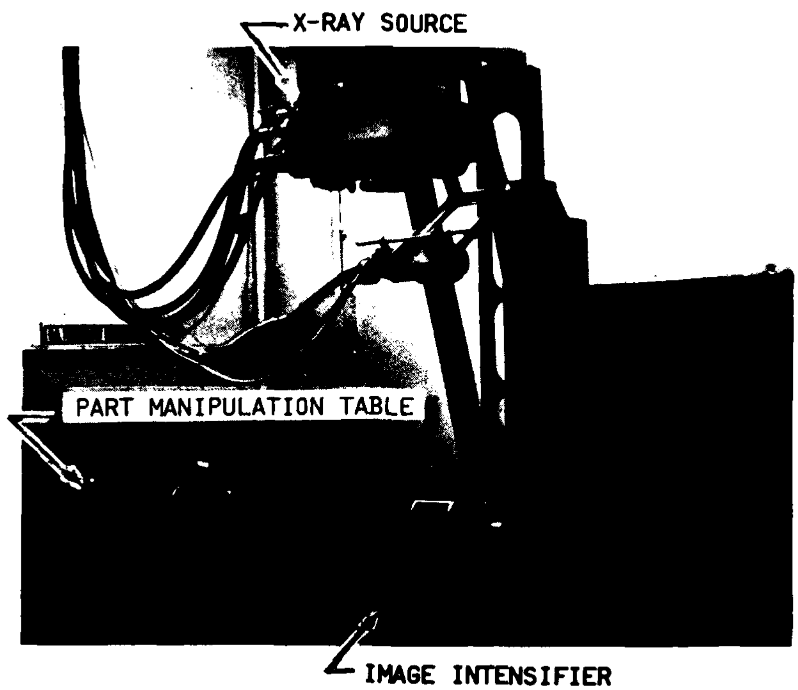


FIGURE 3.1-3 X-RAY SOURCE AND IMAGE INTENSIFIER CONFIGURATION

3.2 REAL TIME RADIOGRAPHIC EQUIPMENT

The equipment necessary for real time radiography, in addition to a source of X-rays, falls into two categories: (1) the conversion of X-ray light to visible light, and (2) the viewing of the converted radiation.

Fluorescent screens convert X-ray light to visible light. They are made from a variety of materials, and are generally designed for specific applications. X-ray image intensifiers contain a fluorescent material but amplify the light output by several thousand times. As a result of the intensification, however, the image contrast is significantly reduced, resulting in a lower dynamic range than that of fluorescent screens.

Direct viewing of a fluorescent screen or image intensifier is not practical because of the geometry, radiation hazard, and low light level. A video camera and remote monitor is a convenient system for viewing the visible image. There are two video tubes commonly used in this application: vidicon and isocon. The vidicon is an inexpensive tube but has low sensitivity and dynamic range and is blinded by high light levels. The much more expensive isocon tube has high sensitivity and a wide dynamic range. A Sierra Scientific Corp. Model LSV-1 video camera with a antimony trisulfide vidicon tube was used during this study because of availability and cost.

Two image intensifiers were utilized at different times, Machlett Laboratories, Inc. Models 22D20R and 17D20. The camera and intensifier were optically coupled by two KOWA fixed focus lenses, both 42 mm @ f/1.1.

3.3 IMAGE PROCESSOR

The minimum requirements established for this system are as follows:

1. Video input: Analog to digital converter, 8-bit resolution, 10 MHz sample rate minimum.
2. Video output: Digital to analog conversion controlled by table lookup and/or bit level manipulation.

3. Memory compatible with video in/out 512 x 512 minimum, 1024 x 1024 desirable. Bits per pixel must be compatible with functional requirements (12 bits if frame summing is provided, 8 bits if only averaging is provided).
4. Digital input/output: Provisions must be available for parallel input or output at rates greater than 500,000 bytes per second.
5. Programming capabilities: Unit must have capability of control of its function via an outside computer. Such functions must include as a minimum:
   - Summation of specified number of frames or as an alternative, averaging of a specified number of frames.
   - Inversion of memory or alternate subtraction of specified number of frames.
   - Overlay via computer control ASCII characters or symbols.
   - Desired option: Ability to manipulate sections of memory via the computer independent of the rest of memory, commonly termed: scroll, zoom, split screen, quartering, window transfer, psuedo color.

A summary of available systems and their acceptability is given in Figure 3.3-1. Two systems met the minimum requirements: the IP-5000 manufactured by DeAnza Systems, Inc., and the Model 70/E manufactured by Stanford Technology Corporation. The Model 70/E image processor was selected because of the following advantages: The input/output transfer rate was four times faster than the IP-5000. The time for conversion from video to digital with 8-bit resolution was four times faster in the Model 70/E. Processing speeds for additions, subtractions, multiplications, etc., were as much as 17 times faster in the Model 70/E. The Model 70/E has hardware histogram generation and hardware min-max pixel intensity calculation as opposed to software generation in the IP-5000. The software package and documentation also was better for the Model 70/E.

3.4 COMPUTER SYSTEM

The computer selection for this project was based on the ability to meet the specific hardware, execution speed, and software requirements to facilitate development and to execute implemented tasks.

VIDEO SYSTEMS	INPUT		MEMORY		PROCESSING (MEMORY)			PROCESSING (OUTPUT)	CPU INTERFACE	ALPHA NUMERIC	CURSOR/ JOYSTICK	PSEUDO COLOR	WINDOW TRANSFER	SOFTWARE CONVOLUTION	MISC COMMENTS
	DIGITAL IN	VIDEO IN	512^2	1024^2	AVG	SUM	SUB								
QUANTEX CORP DS-20	●	● 512 LINES	●		●	●	●	CONTRAST ENHANCE BIT LEVEL	16 BIT, IEEE 488						
RAMTEK CORP	●		●	●	●			PROGRAMMABLE LOOK UP TABLE	16 BIT	●	●	●	●		
GRINNELL SYSTEMS GMR-27	●	● 512 LINES	●	●	●	●	● FRAME	PROGRAMMABLE LOOK UP TABLE	16 BIT	●	●	●	●		SCROLL, ZOOM BYTE-PACKING
GENISCO COMPUTERS	●		●	●				PROGRAMMABLE LOOK UP TABLE	16 BIT SEMI DMA	●	●	●			SCROLL, ZOOM
COMTAL CORP VISION ONE	●	*	●	●	SMOOTHING HISTOGRAM CONVOLUTION	●	● FRAME	PROGRAMMABLE LOOK UP TABLE	16 BIT	●	●	●	●		ZOOM, PAN * NO DETAILS
HAMAMATSU TV CO. LTD		● 1024 LINES							16 BIT						REQUIRES SPECIAL CAMERA NO VIDEO OUTPUT
COLORADO VIDEO INC.		● 512 LINES	● 256 x 512												
STANFORD TECHNOLOGY CORP SYSTEM 501	●	● 512 LINES	●		●	●	●	PROC. LOOK UP TABLE	16 BIT (DIFF.)	●	●	●		●	ZOOM, SCROLL
AYDIN CONTROLS GRAPHICS DISPLAY GEN	●									●					GRAPHICS ONLY - NO GREYSCALE
DE ANZA SYSTEMS INC. IP 5000	●	● 512 LINES	●		●	●	●	PROC. LOOK UP TABLE (INPUT)	16 BIT	●	●	●		●	ZOOM, SCROLL
CSP INC.		●	180 OR LARGER						16 BIT						SCROLL
LEXIDATA CORP.	●		●					PROC. LOOK UP TABLE	16 BIT	●	●	●			ZOOM, SCROLL
SPATIAL DATA SYSTEMS INC.		●						PROC. LOOK UP TABLE	16 BIT RS232	●	●	●			
PRINCETON ELECTRONIC PRODUCTS PEP 500		●		● *											* TWO HOUR RETENTION ON SCREEN ZOOM

FIGURE 3.3-1 IMAGE PROCESSING SYSTEM COMPARISONS

Also, the memory management system must manage a large records data base, control mechanical motion, and must be capable of executing a large program that manipulates an image in memory. Six systems were examined after preliminary screening. A comparison is given in Figure 3.4-1. Two of these computers, the Hewlett-Packard 1000 and the Prime 550 were examined in detail.

Memory

The Prime 550 memory capacity of 8 MB of real memory and 32 MB of user memory by means of the virtual memory feature exceeds present and probably future requirements. HP memory capability does not meet these requirements, but a means of swapping between programs is provided. This would require development of programs in segments, increasing programming costs and greatly increasing execution time.

Software

The software capabilities of the Prime exceed that of the HP, although the HP does provide the software tools necessary to meet minimum requirements. Prime provides full implementation of FORTRAN IV while HP does not, but HP does provide work-around methods.

Speed

One of the main purposes of the computer is to control the digital image system and the possible manipulation of large data arrays (up to 512 x 512). A benchmark program was written to define the exact speed of the two computers performing the type of calculations encountered in the application. The result of this benchmark test showed a speed advantage of better than 2.1x for Prime over HP.

KEY: ● MEETS RQMTS; N.D. NOT DETERMINED; ○ COVERED ELSEWHERE	DISK SIZE	MAG TAPE	PROG. SIZE	DATA SIZE	SOFTWARE			SPEED OF FIN. SW	COST	SOFTWARE DEV. COSTS	NOTABLE FEATURES	COMMENTS	REASONS FOR SELECTION
REQUIREMENTS	50MB MIN.	800/1600 bpi SWITCH-ABLE	120KB MIN.	375KB MIN. 2.1MB MAX	MULTI-USERS MIN. 3	FORTRAN IV W/FILE EXTENSIONS	DATA BASE MGMT	SPEED RQMTS BASED ON MOVING LARGE ARRAYS	<100K	COSTS ESTIMATED ON EXPERIENCE W/DATA GNRL, HEWLETT-PACKARD, AND PRIME	ADVANTAGES APPLY TO OVERALL PROJECT SUCCESS		
PRIME 550	64MB	●	32MB (INCL DATA)	● 1	63 MAX	●	●	VERY FAST 2	99.85K INCL. DISCOUNT	MUCH BELOW AVERAGE	TRUE VIRTUAL MEMORY FORTRAN DEBUG REMOTE DIAGNOS-TICS	1. MEMORY CAPACITY = 8MB PORG + DATA = 32MB VIRTUAL MEM. 2. BENCHMARK TEST SHOWS 2.1X FASTER THAN HP	MEETS MAX. REQMTS. HIGHEST PERF. PER COST RATIO
HEWLETT-PACKARD 1000	50MB	800 [1] bpi OR 1600 bpi	54KB	1.8MB	64 MAX	○ 2	●	FAST	80.86K INCL. DISCOUNT	HIGH	FORTRAN IV NOT FULLY IMPLEMENTED DIFFICULT IMPLE-MENTATION OF LARGE PROGRAMS	1. REQUIRES SUBSTI TUTION OF OTHER BRAND (UNKNOWN) 2. ANSI STD FORTRAN NOT IMPLEMENTED, OTHER MEANS PROV.	OVERALL COST HIGHER THAN PRIME, DOESN'T MEET MAX REQMTS
DATA GENERAL S/130	50MB	●	64KB INCL DATA	●	2 MAX	●	ADDITIONAL COST	SLOW	90 LESS DISCOUNT	HIGHEST	MEMORY USE VERY DIFFICULT OVER 64KB PROG + DATA		PERFORMANCE TOO LOW
DIGITAL EQUIP. CORP. PDP 11/34	176M	800 bpi	56KB INCL DATA	●	MULTIPLE	●	N.D.	N.D.	101K + + PERIPH.	AVERAGE			DOES NOT MEET ALL REQMTS
DIGITAL EQUIP. CORP. VAX 11-780	67MB	●	32MB INCL DATA	●	96 MAX	●	●	N.D.	153K + PERIPH.	BETTER THAN AVERAGE			COST TOO HIGH
PRIME 400	80MB	●	32MB INCL DATA	●	63 MAX	●	●	VERY FAST	140K + PERIPH.	MUCH BELOW AVERAGE			COST TOO HIGH

FIGURE 3.4-1 COMPUTER COMPARISONS

Maintainability and Reliability

The selection of the prime computer over the Hewlett-Packard was also made due to the maintainability and reliability of the computer. The Prime computer has proven to be reliable, and the diagnostic capabilities have proven to be effective. In one case, the diagnostic program located a bad memory chip, and since the chip was mounted in a socket, it was easily replaced.

3.5 EQUIPMENT INTERFACING

The interconnection of most subsystems is either inherent in a subsystem or a simple switching control to route signals to manual controls or automatic controls. The exceptions are the interfaces between the Prime 550 computer and both the STC Model 70/E image processor and the motor control.

The image processor interface includes both software and hardware components. The hardware was designed around the requirements of STC Model 70/E hardware and software. The interface software design makes the hardware compatible with the STC user programs. The interface was built on the Prime General Purpose Interface Board (GPIB) and installed in the computer. Two cables connect the STC image processor to the GPIB. The details of the interface board and software driver are included in Appendices 1 and 2.

An interface between parts movement and computer or operator was designed around joy sticks, the type used in the hobby industry. The design allows either manual or computer control of the part manipulation table. Control is provided for X, Y, and rotational parts movement, X and Y lead mask position, X-ray tube height and X-ray voltage and current settings. The details of the motor control interface design and the software driver are included in Appendices 3 and 4.

4.0 RADIOGRAPHY

Radiography is the standard quality assurance inspection technique used for a wide variety of applications, such as assembly verification and inspection of casts and welds. Excessive costs and flow times have made film-based techniques increasingly prohibitive, causing industry to search for non-film radiographic inspection methods.

4.1 REAL TIME RADIOGRAPHY

Real time radiography is a non-film technique that uses a TV camera and monitor to display the image instead of capturing it on film. In addition to eliminating the cost of film and reducing flow time, real time radiography offers an additional advantage—that of motion.

4.1.1 THE ADVANTAGE OF MOTION

Real time radiography allows movement of the test part during the radiographic inspection. This is one major advantage that real time X-ray has over film radiography for the inspection of most complex items. Motion of the part, especially rotation, allows the observer to integrate the total picture and build a three-dimensional impression, greatly enhancing the ability to detect and identify flaws and perceive their location.

When a part is in motion, small flaws may be easily differentiated from background noise or system imperfections. The ability to view a part in motion provides a rapid means of scanning complex parts at various angles, allowing more reliable identification of any defects.

The lower resolution inherent in real time radiography is compensated for by the advantages of motion. Real time X-ray easily permits 100% inspection of a part, which is impractical with film techniques for most applications.

4.1.2 METHODS OF REDUCING SCATTERED RADIATION

Real time systems do not as yet provide the quality that has been developed with film methods. The system used in this project will resolve thickness changes in aluminum down to about 2% under optimum conditions while film can usually resolve changes much less than 2% (2T). Under less than ideal conditions, resolution and contrast suffer from scattered radiation from complex parts and from the greater distance between the fluorescent screen and the object being tested.

Scattered radiation may be reduced by masking off areas that do not contribute to a specific point of interest. This has been accomplished by remotely controlled lead shields that can be closed from two directions (X & Y) reducing radiation from the sides.' This has an added advantage for the vidicon tube, which is easily blinded by areas of high intensity light. For example, if the point of interest is in a thick section of the missile, the adjacent thin sections can be masked off by remote control.

Since lower energy photons tend to be more easily scattered, they may be reduced somewhat by filtration from the X-ray beam. Filtering may be accomplished by placing a thin film of lead over the X-ray tube.

The medical profession uses a collimating diaphragm composed of many thin closely spaced lead sheets sandwiched between transparent spacers. The lead sheets are parallel to the X-ray beam, allowing it to pass, but blocking nearly all scattered radiation. The diaphragm, also called a grid, is placed between the object and the fluorescent screen.' This system was evaluated and appears to be of some benefit.

4.1.3 VIEWING OF THE X-RAY IMAGE

There are two basic equipment configurations used for converting the X-rays to a visible image and transmitting that image to a TV monitor.' The vidicon camera and an image intensifier tube may be optically coupled, as was done for this project, or an isocon camera may transmit the image from a fluorescent screen.

A brief examination of an isocon camera was made using fluorescent screens designed for medical use. It was apparent that even under crude experimental conditions the isocon system is superior to the vidicon system in at least one respect. The low light level sensitivity and extreme dynamic range obviate the need for the intricate masking necessary with the vidicon camera and image intensifier. The only drawback of the fluorescent screen-isocon camera system was an overall lower sensitivity. With the system examined, full X-ray output was required to equal the image intensifier-vidicon brightness at a much lower X-ray output.

The combination of image intensifier and vidicon camera is very sensitive but suffers from a narrow dynamic range and thus is best suited for objects of relatively uniform density. The combination of fluorescent screen and isocon camera have wide dynamic range but require more X-rays (higher energy or greater intensity) to produce a satisfactory image. Therefore, there is a different best system for each application. At this point in the development task, it appears that a very good system able to handle most jobs would be as follows:

- High Energy or High Intensity X-Ray Source
- Selection of Fluorescent Screens
- Isocon Camera
- Selection of Lenses

This setup could produce images of complex parts, and still provide the flexibility to examine details where higher resolution is needed. Greater detail would be achieved by a narrower field of view.

If the application requires examination of very thick parts, for example more than 5 cm of aluminum, the fluorescent screen-isocon system may require integration of many frames to obtain adequate brightness. This would remove the advantage of motion in real time.

4.2 IMAGE PROCESSING

Although the real time system described above permits examination of a part while it is in motion, it does not provide the contrast or resolution of film methods. Image quality may be improved considerably through image processing.

Image processing can be accomplished by two basically different approaches, video signal processing and digital image processing. Video signal processing provides a very rapid response to changes in an image, which is tantamount to doing real time image enhancement. However, it is a very limited and inflexible technique. Digital image processing, a more versatile, computer-controlled method, was selected for this project. Digital image processing technology has advanced rapidly in recent years because of the vast amounts of satellite (LANDSAT) data available for land use planning and other applications. Many of these techniques are directly applicable to radiographic image processing. The processes applicable to this study are fundamentally of four types: noise reduction, edge enhancement, contrast manipulation and color representation.

4.2.1 NOISE REDUCTION

A video image is composed of many adjacent lines with the intensity of each line varying continually along its length. On the other hand, a digital image is composed of rows and columns of picture elements (pixels), each of which has a discrete intensity. A video signal contains a significant level of noise, producing a grainy and confusing effect. The magnitude and distribution of the noise is basically random, and therefore, can be reduced by averaging several images (video frames) within a very short time. The noise level is reduced by the square root of the number of frames averaged. If the object is stationary, a large number of frames can be avaraged, greatly reducing the noise level. Averaging 256 frames reduces the noise by a factor of 16; at an execution rate of 15 frames per second, this requires only 17 seconds. In this project, all images were produced by averaging 256 frames.

A second method of noise reduction, localized averaging, is accomplished by computing the average of a pixel intensity with that of its neighbors. Although this technique smoothes out the noise, it also blurs the image, making the details unclear. This technique is unsatisfactory for radiographic applications.

4.2.2 EDGE ENHANCEMENT

Edges in an image may be poorly defined, particularly when there is not much contrast between an object and its surroundings. Edge enhancement is a method of increasing the contrast where there are edges, thus making them more visible. For example, if a light grey object is surrounded by dark grey, edge enhancement would make the light grey object lighter at the edge, and the surroundings darker at that edge, improving the contrast between the two. Digital edge enhancement transforms the intensity of each pixel based on the intensity of its neighbors. There are several methods of edge enhancement, each producing different results. Three methods of edge enhancement have been examined here: difference, gradient, and Laplacian. When one of these techniques is applied to an image, we are left with only the edges. By adding this result to the original in about a 1:2 ratio, we obtain an image whose edges have been enhanced. This has proven to provide the most aesthetically pleasing results. Edge enhancement techniques naturally result in an increase in noise. For this reason, it is very important to start with the lowest noise image available before performing edge enhancement functions. Low noise can best be achieved by averaging a large number of video frames.

Difference

The difference edge enhancement technique is the simplest of transformations, whereby the intensity of each pixel is replaced by the difference between its intensity and that of an adjacent pixel. This produces an effect like casting a shadow from one side. The technique is fast, requiring only one video frame to obtain the difference, but increases any noise present in the image. Figure 4.2.2-1, an example of the difference technique, was produced by adding the output to the original in a ratio of 1:2 and displaying it with the original in a split screen format.

Gradient

The gradient of an image is its rate of change of intensity with respect to distance in a specific direction. This is a general case of the difference technique. The

FIGURE 4.2.2-1 DIFFERENCE EDGE ENHANCEMENT

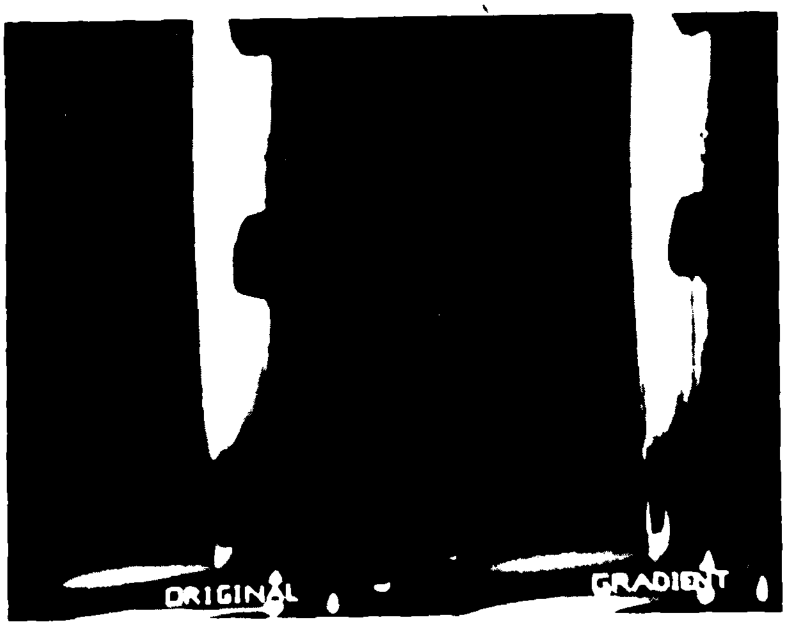


FIGURE 4.2.2-2 GRADIENT EDGE ENHANCEMENT

analytical solution to this problem involves finding the differential equation of each pixel. However, an approximation to this solution may be made by performing a convolution of a small gradient matrix about each pixel. For example, a 3 x 3 north-south gradient matrix would be:

$$\begin{matrix} 1 & 1 & 1 \\ 1 & -2 & 1 \\ -1 & -1 & -1 \end{matrix}$$

The convolution can be performed in 17 video frames. The gradient results in a shadowed edge; its direction can be varied and it is less sensitive to noise in the image. Figure 4.2.2-2 is an example of an east gradient with a 3 x 3 convolution matrix.

Laplacian

The Laplacian transform of an image is its rate of change of intensity with respect to distance without regard to direction. As with the gradient technique, a matrix convolution can be performed as an approximation. The Laplacian transformation being non-directional may be represented by a matrix with symmetry about the center:

$$\begin{matrix} 1 & 1 & 1 \\ 1 & -8 & 1 \\ 1 & 1 & 1 \end{matrix}$$

The output of the Laplacian transformation shows no shadow and amplifies noise. An example is shown in Figure 4.2.2-3. The non-directional nature of the Laplacian transform amplifies all edges regardless of orientation.

These edge enhancement techniques can improve the quality of an image and the observers ability to visualize the original object. The Laplacian technique is often the most useful, especially in complex images, but when the detail in question is linear, as in screw threads, a gradient technique may be better.

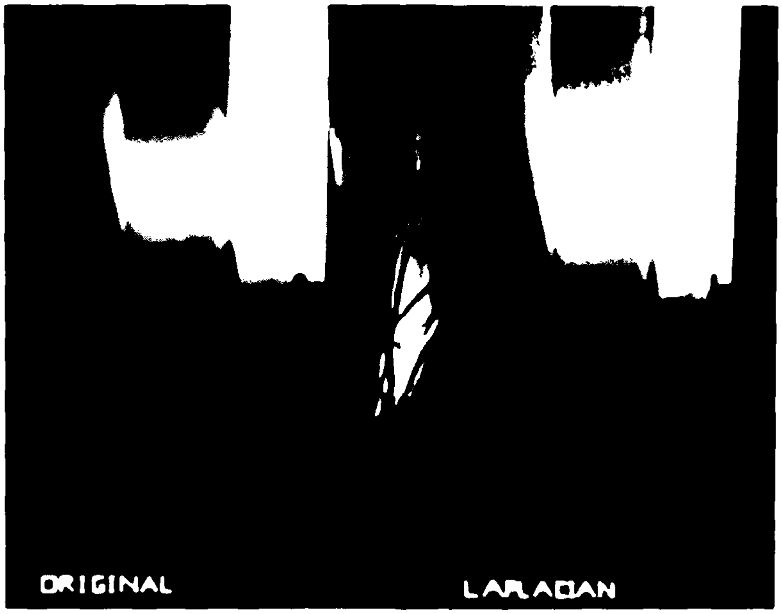


FIGURE 4.2.2-3 LAPLACIAN EDGE ENHANCEMENT

FIGURE 4.2.3-1 LINEAR MAPPING IMAGE ENHANCEMENT

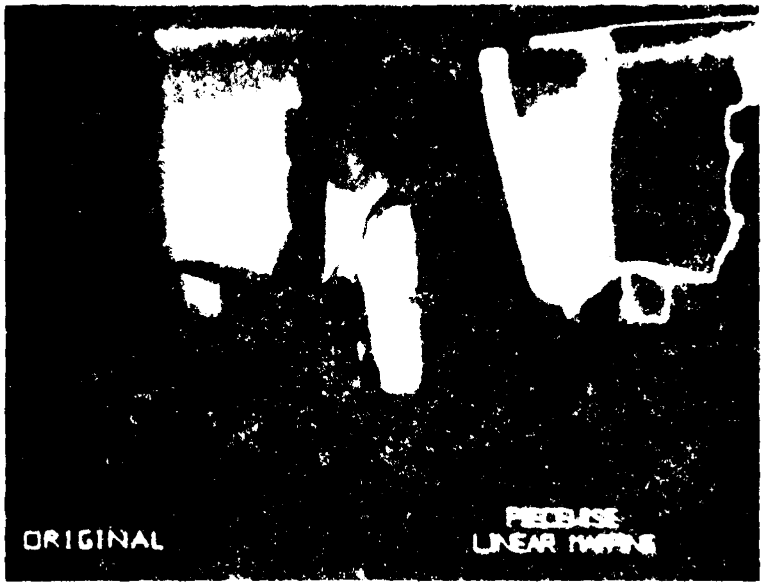


FIGURE 4.2.3-2 PRECISE LINEAR MAPPING IMAGE ENHANCEMENT

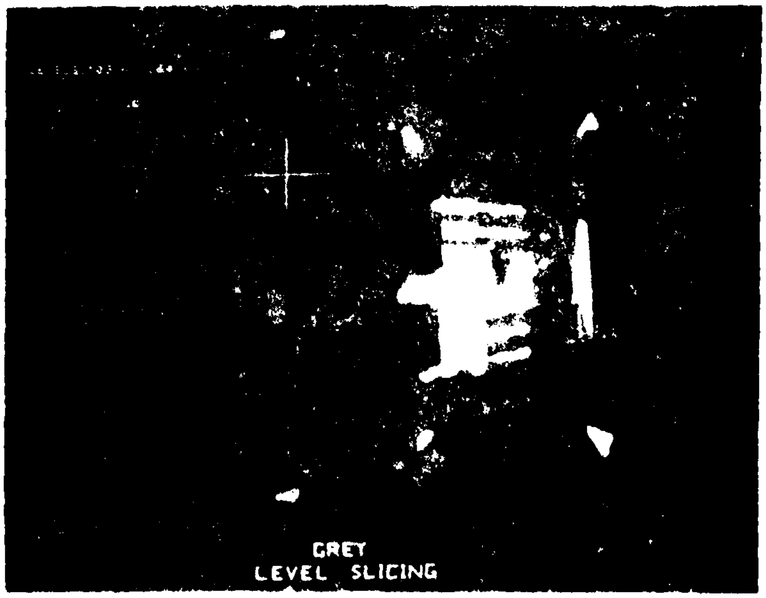


FIGURE 4.2.3-3 COLOR LEVEL SLICING

4.2.3 CONTRAST MANIPULATION

An eight-bit digital image can produce 256 different shades of gray, but the human eye can distinguish only about 64. An image therefore could have detail available that the eye could not see. By contrast manipulation it is possible to stretch the gray scale in one regime at the expense of another. For example, detail may be brought out in the dark areas by a logarithmic rescaling, or detail in the light areas may be brought out by an exponential rescaling.

Digital image processors perform contrast changes by means of a look-up table translation (mapping). Thus a table with 256 entries may translate any original level to any other chosen level.

The most useful means of modifying an image while maintaining the overall information is linear expansion of a certain gray regime. This technique, called piecewise linear mapping, gives the operator a nearly infinite range of contrast modifications. Figure 4.2.3-1 shows a linear mapping of an image that lacked the full range of intensities. Figure 4.2.3-2 shows an extreme modification where all intensities outside the regime of interest were mapped to zero (black).

Gray level slicing is a technique where all intensities below a selected value are set to black and all others set to white, giving a marked delineation at that intensity. Another means of viewing the same information is through color level slicing. In this technique the image is left intact but all intensities within a chosen regime are overlayed with a contrasting color. When this feature is coupled with a track ball, joy stick or other interactive means, it is possible to bring out subtle changes in intensity not visible to the eye. Figure 4.2.3-3 shows an example of color level slicing.

4.2.4 COLOR REPRESENTATION

Although the human eye can differentiate only about 64 different shades of gray, it can distinguish many times that number of shades of colors. For this reason it is often advantageous to add the color dimension to the image, allowing the observer

to see smaller changes in intensity. Pseudocolor is a function which assigns a selected color to each gray level intensity. Figure 4.2.4-1 shows an example of the pseudocolor operation.

4.2.5 SOFTWARE OPERATIONS

The Stanford Technology Corp. Model 70/E image processor has been designed to be very flexible and accept all controls from a computer. STC provides a software package, System 500, which is primarily designed for satellite data processing. Application of the system to this task and in particular to the Prime 550 computer required some software modification and creation of two additional image processing functions.

Software Translation

The System 500 software, while written in FORTRAN IV, necessarily contained significant machine-dependent code. This fell into four general areas: hardware

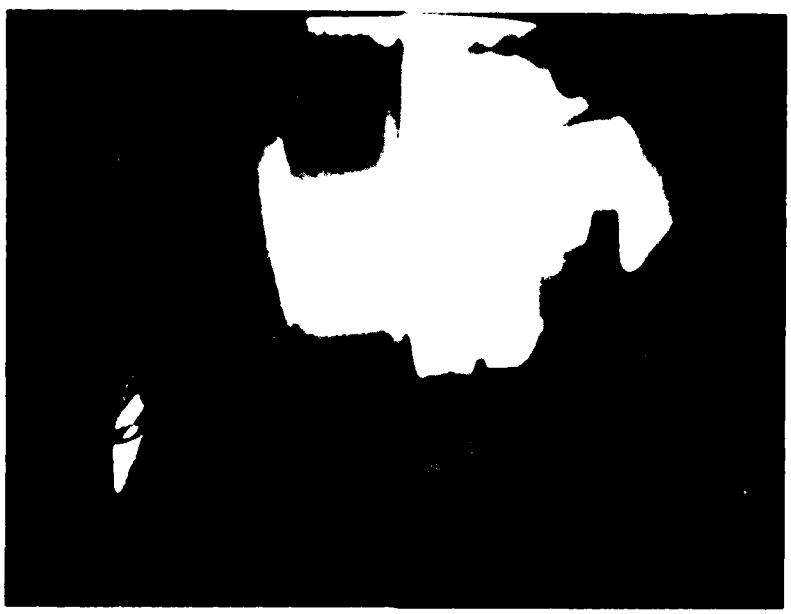


FIGURE 4.2.4-1 PSEUDOCOLOR IMAGE ENHANCEMENT

drivers (discussed elsewhere), input and output to peripherals, bit manipulation, and program segmentation and swapping. The large size of the System 500 package required the program segmentation to function in a 16-bit computer. These segments are swapped into the computer memory as required to execute a given process. The Prime 550 is designed around virtual memory and an entirely different scheme for executing large programs. The program swapping features were removed, and actual addresses were converted from two byte integers to four byte integers. Other changes were handled by FORTRAN callable subroutines supplied by Prime Computer Inc. These subroutines are described in appendix 7.

Software Additions

Two capabilities necessary for this task were missing from the System 500 software: the ability to accumulate video frames (averaging or time-smoothing), and the ability to easily preserve the output of one operation for use in the next operation. These two functions are described in detail in appendix 6. The first function, subroutines DAVG and DAVGD, was implemented to average a specified number of video frames in the processor's 16-bit accumulator, then convert to an 8-bit image.

The result of an image process exists as the output of a transformation. In order to use this resultant image for further processing, this output must be stored in one of the image planes. The function to save consists of subroutines SAVE and SAVED and allows the result of a process to overwrite the original image or to be saved as a new image in another image plane.

4.3 RADIOGRAPHIC QUALITY

Radiography is a technique analogous to projecting a shadow of a transparent object. All of the parameters affecting the sharpness of the shadow apply to radiography: the relative size of the light source, the distance between shadow and object and light source, smoothness of the surface, etc.

The important features which determine radiographic quality are resolution, sensitivity, and contrast. Silver halide film used in photographic film radiography is very good with respect to all of these properties and the techniques necessary to attain the highest possible quality with film are well understood. The major drawbacks to this technique are the high labor and material costs and long flow times.

4.3.1 PARAMETERS AFFECTING RESOLUTION

The resolution of an image is a function of many parts of the total system. One of the key parameters is geometric unsharpness, which is dependent upon the focal spot size of the x-ray beam and the relative distances from the object to the x-ray source and to the screen (or film).

The focal spot size is measured by locating a lead plate with a pin hole midway between the source and a radiographic film. It is then calculated as the size of the image less twice the size of the pinhole. Measurements made in this manner are summarized in Figure 4.3.1-1. As indicated, no significant change in spot size was observed over the range of experimental conditions. The average values also agree with the values quoted by the supplier.

The geometric unsharpness is calculated using the formula

$$U = F \times (t/D),$$

where: U = Geometric unsharpness
F = Focal spot size
t = distance from object to screen
D = distance from X-ray source to object

For this system, t = 14 cm (5.5 in.) and D = 213 cm (7 ft.). The U calculated for the large (4.0 mm) spot is 0.26 mm and for the small (1.9 mm) spot is 0.13 mm. These values reflect a basic limitation in the X-ray system, which affects both film and

non-film resolution. Thus, one advantage film has over fluoroscopic systems is that "t" can be made very small by placing the film in contact with the object.

Fluoroscopic systems and film both have inherent limitations in resolution. For example, the image intensifier Model 22D20R is advertised to have a maximum resolution of 0.23 mm normal and 0.18 mm high magnification.

The video portion of a real time X-ray system provides several possible sources of resolution limitation. The most significant of these are signal-to-noise ratio, bandwidth, and total number of raster lines. For example, normal video systems display about 480 lines, while image processor systems usually display 512 lines with 512 points per line. The optical coupling between the image intensifier and video camera in this system produces a ratio of screen size to object size of 2.1 for normal and 3.2 for high magnification. This means that the distance between picture elements (pixels) represents 0.24 mm and 0.16 mm at the object for normal and high magnification, respectively.

VOLTAGE, KV	LARGE SPOT, mm	SMALL SPOT, mm
180	4.12, 4.42	1.92
160	3.97, 3.97, 4.12	1.72
150		1.97
140	4.32, 3.87, 3.82	2.02
120	4.17, 3.67, 3.77	1.92, 2.37
100	3.97, 3.62, 3.72	1.87
80	4.07	1.82
60	4.02	1.87
40	4.02	1.92
AVERAGE	3.98	1.93
STANDARD DEVIATION	0.22	0.17
PROBABLE ERROR	0.14	0.11
ADVERTISED	4.0	1.5

FIGURE 4.3.1-1 MEASURED FOCAL SPOT SIZE FOR PHILLIPS ELECTRONICS INSTRUMENTS, INC. MODEL MCN 321

These three limiting factors are summarized in Figure 4.3.1-2. It is evident that an improvement in either geometric unsharpness or image intensifier resolution would provide very little system improvement without a comparable change in the other. On the other hand, the overall system performance could be improved if a different lens coupling were used to magnify the image and provide more pixels to depict each detail. That is, there should be several pixels (TV lines) representing the minimum detectable detail limit of the image intensifier for maximum system resolution. The minimum frequency response necessary to equal the 0.18 mm resolution is 15 MHz at the line rate of 15,750 lines per second for standard video. Therefore, it is necessary to purchase high quality electronics when assembling a real time X-ray system.

RESOLUTION FACTOR	LIMITATIONS	
Geometric Unsharpness	0.13 mm (small spot)	0.26 mm (large spot)
Image Intensifier	0.18 mm (high mag.)	0.23 mm (normal)
Pixel Separation	0.16 mm (high mag.)	0.24 mm (normal)

Figure 4.3.1-2 Resolution Limitation of Prototype System Due to X-Ray Focal Spot, Image Intensifier and Video Display

4.3.2 MEASUREMENT OF RESOLUTION

Quality level, a measurement affected by resolution, sensitivity and contrast, is the parameter radiographers generally use to describe the performance of an X-ray system. The penetrameter is used for this measurement and is a piece of material of specific thickness (2% of material being radiographed) with three holes, the diameters of which are 1, 2, and 4 times the thickness of the penetrameter. The penetrameter thickness used for 2.54 cm (1.0") material is 0.0508 cm (0.02"). The quality level is expressed as the penetrameter thickness and the smallest hole size visible, e.g., 2%-2T = .04" dia. hole in .02" thick penetrameter on material of 1" thickness. With the system described here, using aluminum plate and aluminum

penetrameters, results are a function of object thickness. for example, Figure 4.3.2-1 shows the quality levels of real time X-ray and image enhancement. Gray level slicing, a method of contrast manipulation, was the method of image enhancement used to emphasize the penetrameter holes.

ALUMINUM THICKNESS	QUALITY LEVEL	
	REAL TIME RADIOGRAPHY	IMAGE PROCESSING
3.81 cm (1:5)	4% - 2T	2% - 2T
2.54 cm (1.0)	4% - 2T	2% - 2T
.92 cm (.375)	4% - 2T	4% - 2T

Figure 4.3.2-1 Penetrameter Sensitivity

4.4 RADIOGRAPHIC RECORDS

The elimination of X-ray film necessitates using an alternate method of image storage. The requirements for such a method are: the image must be stored for a long time, it must be easy to retrieve, it must retain the original quality of the image, it must be able to be entered back into the imaging system, and it must have a low cost per image.

The following types of storage methods were examined: video tape, video disc, microfiche, digital disc and digital tape. Research into video tape and video disc recorders determined that they were limited to recording 480 lines of video image, whereas the image processor produced 512 lines of image. In order to use either of these two types of recording methods, a converter would have to be used, which would result in lost information. Also, the bandwidth of video recorders was much lower than that required by the image processor, unless very high quality recorders are used. Image retrieval from video tape is difficult since images have to be read sequentially. Images stored in video form could not be entered into the image processor and therefore could not be used to recreate the image process that leads to the pass/fail decision.

Images could be stored on microfiche in digital format without loss of information. However, once an image is put on microfiche, there is no way to enter the data back into the system.

Digital discs offer fast storage and easy retrieval, but have an extremely high cost per image. In contrast, digital magnetic tape has a very low cost per image. Digital storage on tape or disc permits easy re-entry of the image into the system and retains all information. Digital tape has moderate retrieval time.

Thus, it is felt that image storage on digital tape best meets storage requirements.

5.0 COMPUTER-AIDED INSPECTION

One of the goals of this project has been to demonstrate a prototype computer-aided inspection system. In the automated non-film radiographic system, the computer controls parts positioning, records management, and the functions of an inspection plan.

5.1 CONCEPT

The automated system provides computer control of the manual functions that are labor intensive or sensitive to human error. These primarily fall into the category of data recording and retrieval. Examples of this are: inspection plan preparation and dissemination, inspection results recording and retrieval, and radiograph (image) storage and retrieval. A successful system must have certain basic capabilities. Among these are: simple plan preparation and modification procedures, minimum input from the operator (radiographer), and maximum traceability (retrieval of records, re-creation of inspection, etc.).

5.2 SOFTWARE DESIGN

The automated inspection system software design is detailed in Appendix 5. The program, termed CAI, for computer aided inspection, has three basic functions: inspection, planning and data retrieval.

The key to a useful computer-aided system is in the design of the software - its flexibility and ease of operation by the user. The easier it is for the user, the more sophisticated the software must be. This prototype system has been designed with enough sophistication for demonstration purposes but would require minor improvements for use in a real environment. An overview of the data base design is shown in Figure 5.2-1. The inspection plans are actually composed of three separate files: first, the plan main records, each containing primarily a list of test names; second, the plan test file, containing records with the basic data for a specific test such as motor and position parameters, special instructions for the inspector and names of image processing functions; and third, image processing command file with each record containing a series of image processing commands.

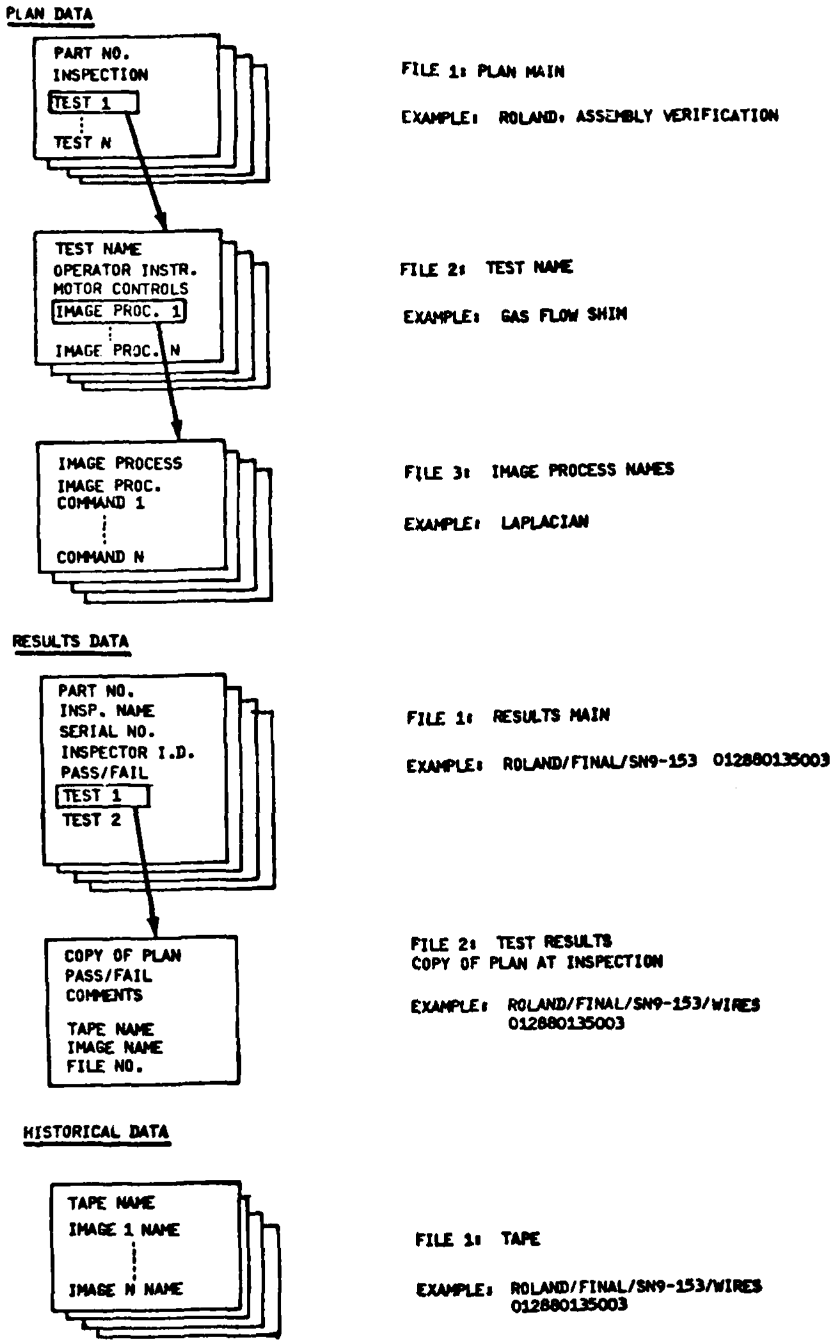


FIGURE 5.2-1 COMPUTER-AIDED INSPECTION DATABASE

This data base structure allows the planner to create a new plan by merely assembling a list of tests in the order desired. The computer then accesses those tests by name from the various files at the time the inspection is performed. As the inspection is performed, the test results are saved (pass-fail and inspector's comments) along with a copy of the test plan. The last file maintained by the system is the image storage file, a cross reference of magnetic tape names, image names, and unique inspection names.

An overview of the CAI system is shown in Figure 5.2-2.

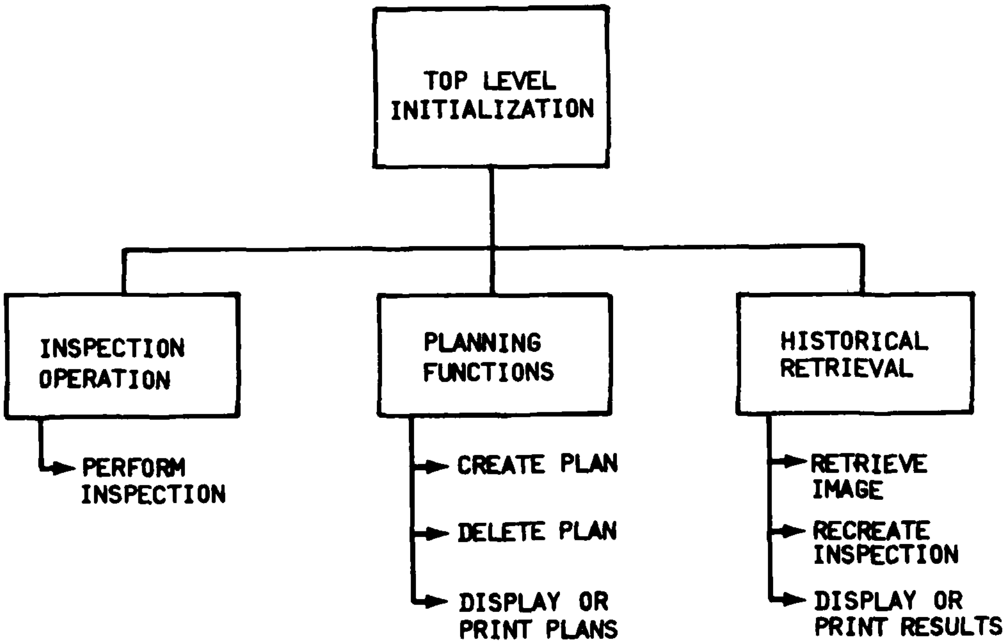


FIGURE 5.2-2 COMPUTER-AIDED INSPECTION SYSTEM

5.2.1 INSPECTION

The inspection function of CAI is designed around a of data base management system (DBMS), in this case Prime's multiple index data access system (MIDAS). A CAI system was designed to interact with an inspector who has no knowledge of image processing. The operator need only enter, at a keyboard, his identification (Stamp No.), the Part No. to be inspected, name of the inspection, and the part's serial number. The computer will access a data base containing the inspection plan for that part. That plan will contain all of the necessary data to run the test: coordinates to position the part, functions and parameters to control the image processor, and instructions for the inspector indicating the key inspection criteria. The inspector then enters a pass/fail decision and any observations for future reference. These data are then saved in the historical data file and a copy of the image is recorded on digital magnetic tape.

An overview of the inspection function of the system is shown in Figure 5.2.1-1.

5.2.2 PLANNING

The planning functions are, like the inspection functions, designed around a data base management system. These tasks are greatly enhanced by a screen editing capability. Screen utilities are a software package designed to allow interactive data entry. In this case a planner sits at a CRT terminal and modifies existing plans or creates new plans by entering data into specified fields. The data transferred to the data base is controlled by the screen format and the application program (software). Examples of these screens are shown in Figure 5.2.2-1.

The planning package provides the following operations:

1. Create new plan records.
2. Modify existing plan records.
3. Make new records from old.
4. Delete plan records.
5. Display or print plan or result records.
6. Display or print lists of existing records.

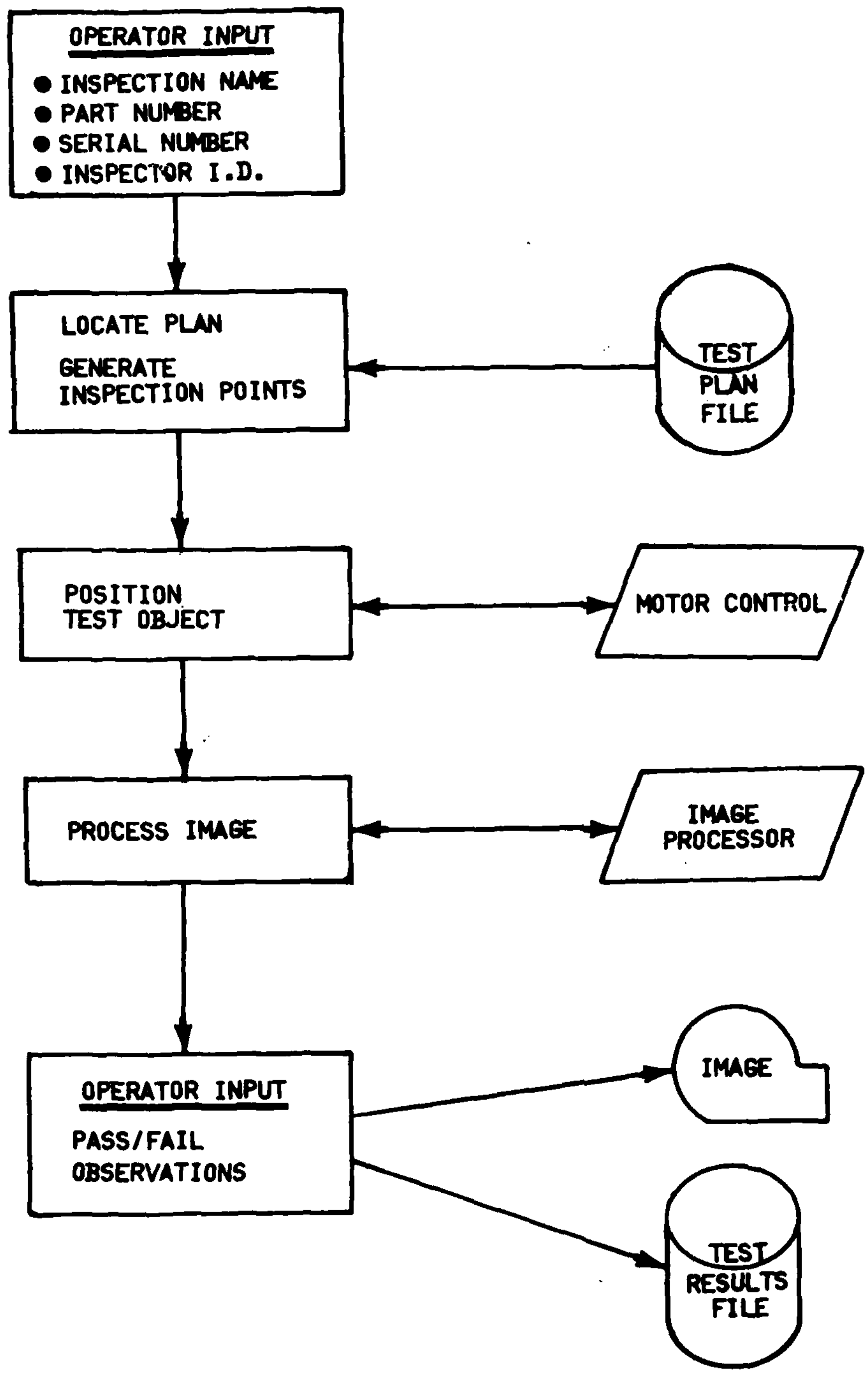


FIGURE 5.2.1-1 INSPECTION SUBSYSTEM

```
          INSPECTION TEST PLAN
PART NUMBER:        -------------------
INSPECTION NAME:    -------------------
NUMBER OF TESTS:    --
TEST  1 NAME:       -------------------
TEST  2 NAME:       -------------------
TEST  3 NAME:       -------------------
TEST  4 NAME:       -------------------
TEST  5 NAME:       -------------------
TEST  6 NAME:       -------------------
TEST  7 NAME:       -------------------
TEST  8 NAME:       -------------------
TEST  9 NAME:       -------------------
TEST 10 NAME:       -------------------
```

```
TEST NAME: --------------------    DESCRIPTION: -----------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
MOTOR MASK:  X POSITION -----  X SPEED --- Y POSITION ----- Y SPEED ---
MOTOR TABLE: X POSITION -----  X SPEED --- Y POSITION ----- Y SPEED ---
MOTOR ROTATION POSITION -----    SPEED ---
IMAGE PROCESS 1 ---------------------------------------------- CODE: -
IMAGE PROCESS 2 ---------------------------------------------- CODE: -
IMAGE PROCESS 3 ---------------------------------------------- CODE: -
IMAGE PROCESS 4 ---------------------------------------------- CODE: -
IMAGE PROCESS 5 ---------------------------------------------- CODE: -
IMAGE PROCESS 6 ---------------------------------------------- CODE: -
IMAGE PROCESS 7 ---------------------------------------------- CODE: -
IMAGE PROCESS 8 ---------------------------------------------- CODE: -
```

FIGURE 5.2.2-1 PLANNING SCREEN FORMATS

5.2.3 RETRIEVAL

In order that the data be of value, there must be a means of retrieval of all data and re-creation of the original conditions that allowed the inspector to make a pass or fail decision. To provide these capabilities, it is necessary to not only save the image and results of inspection but also a copy of the inspection plan at the time of inspection. This is necessary because of the possibility that the inspection plan records may be modified or deleted between the time the inspection is performed and the time when it is recreated. These minimum capabilities have been included in the prototype computer aided inspection system. The full details are included in Appendix 5.

5.3 APPLICATION TO ROLAND FINAL INSPECTION

A test plan was made for final assembly verification of the ROLAND propulsion unit, based on the evaluation of image processing techniques at each inspection point. A summary of the optimum image processing sequences is given in Figure 5.3-1. All of the inspection points could be seen with real time X-ray, but image processing greatly improves the operators ability to interpret the images. Full grey scale utilization is useful at all inspection points, and can be achieved by contrast modification. Some areas, such as those with screw threads, can be made sharper by edge enhancement. Missile position was controlled by the test plan.

Lead mask position and X-ray energy can be part of the plan, also. Use of the prototype test plan provided data for flow time estimates. The inspection of each missile should take approximately 20 minutes. Since the ROLAND missile was still in the development stage during this project, inspection requirements may change before full rate production is initiated. The test plan would then be changed accordingly.

INSPECTION AREA	PROCESSES PERFORMED	STC IMAGE PROCESSOR COMMANDS
1. Inhibited Grains	Contrast Modification	$A>SCALE;
2. O Rings	Contrast Modification	$A>PLIM(BR=40 0 170 255);
3. Gas Flow Shim	Contrast Modification	$A>SCALE;
	Gradient Edge Enhancement	$A>SAV>$B;
		$A>SAV>$C;
		$C>CONV(NR=3 NC=3
		W=/-1 1 1 -1 -2 1 -1 1 1);
		$A $C>ADD(*MINMAX);
		$A $C>SAV;
	Contrast Modification	$A>SCALE;
4. Snap Ring	Contrast Modification	$A>SCALE;
5. Igniter Wires	Contrast Modification	$A>SCALE;
	Laplacian Edge Enhancement	$A>SAV>$B;
		$A>SAV>$C;
		$C>CONV(NR=3 NC=3
		W=/-1 -1 -1 -1 8 -1 -1 -1 -1
		$A $C>ADD(*MINMAX);
		$A $C>SAV;
	Contrast Modification	$A>SCALE;
6. Nozzles	Contrast Modification	$A>SCALE;
	Gradient Edge Enhancement	$A>SAV>$B;
		$A>SAV>$C;
		$C>CONV(NR=3 NC=3
		W=/-1 1 1 -1 -2 1 -1 1 1);
		$A $C>ADD(*MINMAX);
		$A $C>SAV;
	Contrast Modification	$A>SCALE;

Figure 5.3-1 ROLAND Image Processing Sequence

6.0 COST - BENEFIT

Real time X-ray radiography would be of benefit to nearly any application. The cost and flow time can be reduced significantly compared to film radiographic techniques. A possible cost reduction of 10:1 in high volume applications is anticipated. Computer aided inspection would benefit the inspection of parts from high volume production, providing a potential for even greater savings.

The final assembly verification of the ROLAND missile may be improved by a cost reduction of about 8:1 by the implementation of real time X-ray. The capital costs of implementation of the system described in this project are listed in Figure 6.0-1. Using these values and applying methods of investment analysis it is possible to draw conclusions about the feasibility in a specific application. Figures 6.0-2, and 6.0-3 illustrate the investment analysis results. The assumptions used in the analysis are as follows: 8 year depreciation, 10% tax credit, 5.4% sales tax and 24 month payback (44.5% rate of return).

This analysis predicts that the annual savings must be greater than $45,000 in order to achieve a two year payback of the $70,000 capital investment required for real time X-ray equipment only. The complete system, providing image processing and computer aided inspection as well as real time radiography costs $300,000. This expenditure could be justified if an annual cost savings of $193,000 could be realized.

EQUIPMENT	CAPITAL THOUSANDS	TOTAL
I. Real-Time-X-Ray		
1. X-Ray to Visible Light Conversion and Camera	44	
2. Monitor	5	
3. Room Monitor	1	
4. Part Manipulator	20	
SUBTOTAL		70
II. Image Processing and Computer Aided Inspection		
1. Prime 550 Computer with 1 Mbyte Memory 64 Mbyte Disk Dual Density Tape Drive	150	
2. Computer Interfaces for Image Processor and Part Manipulator	10	
3. Image Processor	70	
		230
GRAND TOTAL		300

Figure 6.0-1 Real Time X-Ray System Capital Costs

INVESTMENT ANALYSIS No. ______ PRELIMINARY / FINAL

Title LOW COST HIGH VOLUME RADIOGRAPHY — Date 1 SEPT 80

Proposed Investment Item(s) — Activation Date 1981

Item 1. Real Time X-Ray System $ 70,000 Life 8 Years — Salvage Value of Existing Eqpmt 0

2. ______ $ ______ Life ______ — Investment Tax Credit 7,000

3. ______ $ ______ Life ______ — Sales Tax 3,780

Total $ ______ — Other Procurement/Installation Expense 0

Year	(1) Operating Costs– Existing Equipment	(2) Operating Costs– New Equipment	(3) Gross Savings Before Taxes	(4) Depreciation	(5) Net Book Value of New Equipment	(6) Gross CFC	(7) Recoverable CFC	(8) Before Tax Profit or (Loss)	(9) After Tax Profit or (Loss)	(10) Net Proceeds From Sale of Existing Equipment	(11) New Equipment Capitalized Cost	(12) Net Cash Flow	(13) Cum Net Cash Flow
0	0	3,780	-3,780	0	0	0	0	-3,780	-1,966	0	70,000	-71,966	-71,966
1	51,429	6,429	45,000	7,778	62,222	9,644	5,787	43,009	29,365	0	0	37,142	-34,823
2	51,429	6,429	45,000	14,583	97,639	7,384	4,430	34,847	18,120	0	0	32,704	-2,119
3	51,429	6,429	45,000	12,639	35,000	5,425	3,526	35,887	18,661	0	0	31,300	29,181
4	51,429	6,429	45,000	10,694	24,306	3,767	2,449	36,754	19,112	0	0	29,800	58,988
5	51,429	6,429	45,000	8,750	15,556	2,411	1,567	37,817	19,665	0	0	28,415	87,403
6	51,429	6,429	45,000	6,806	8,750	1,356	882	39,076	20,320	0	0	27,125	114,528
7	51,429	6,429	45,000	4,861	3,889	603	392	40,531	21,076	0	0	25,937	140,465
8	51,429	6,429	45,000	2,917	972	151	98	42,181	21,934	0	0	24,851	165,316
9	51,429	6,429	45,000	972	0	0	0	44,028	22,894	0	0	23,867	189,182
10													
Total	462,861	61,641	401,220	70,000		30,742	19,131	350,351	189,182	0	70,000	189,182	

PAYBACK PERIOD 2 YEAR(S) 0 MONTH(S)

RATE OF RETURN ON INVESTMENT 44.65 %(After tax)

FIGURE 6.0-2 INVESTMENT ANALYSIS: REAL TIME X-RAY

INVESTMENT ANALYSIS No. ______ PRELIMINARY / FINAL

Title LOW COST HIGH VOLUME RADIOGRAPHY

Date 1 SEPT 80

Proposed Investment Item(s)

Activation Date 1981

Item 1. ______ $ 300,000 Life 8 Years

Salvage Value of Existing Eqpmt 0

2. ______ $ ______ Life ______

Investment Tax Credit 29,999

3. ______ $ ______ Life ______

Sales Tax 16,200

Total $ ______

Other Procurement/Installation Expense 0

Year	(1) Operating Costs– Existing Equipment	(2) Operating Costs– New Equipment	(3) Gross Savings Before Taxes	(4) Depreciation	(5) Net Book Value of New Equipment	(6) Gross CFC	(7) Recoverable CFC	(8) Before Tax Profit or (Loss)	(9) After Tax Profit or (Loss)	(10) Net Proceeds From Sale of Existing Equipment	(11) New Equipment Capitalized Cost	(12) Net Cash Flow	(13) Cum Net Cash Flow
0	220,571	16,200	-16,200	0	0	0	0	-16,200	-8,424	0	300,000	-308,424	-308,424
1	220,571	27,571	193,000	33,333	266,667	41,333	24,800	184,467	125,923	0	0	159,256	-149,168
2	220,571	27,571	193,000	62,500	204,167	31,646	18,897	149,487	77,733	0	0	140,233	-8,934
3	220,571	27,571	193,000	54,167	150,000	23,250	15,112	153,946	80,052	0	0	134,218	125,284
4	220,571	27,571	193,000	45,833	104,167	16,146	10,495	157,661	81,984	0	0	127,817	253,101
5	220,571	27,571	193,000	37,500	66,667	10,333	6,717	162,217	84,353	0	0	121,853	374,954
6	220,571	27,571	193,000	29,167	37,500	5,812	3,778	167,611	87,158	0	0	116,325	491,279
7	220,571	27,571	193,000	20,833	16,667	2,583	1,679	173,846	90,400	0	0	111,233	602,512
8	220,571	27,571	193,000	12,500	4,167	646	420	180,920	94,078	0	0	106,578	709,090
9	220,571	27,571	193,000	4,167	0	0	0	188,833	98,193	0	0	102,360	811,450
10													
Total	1,985,139	264,339	1,720,800	300,000		131,750	81,989	1,502,788	811,450	0	300,000	811,450	

PAYBACK PERIOD 2 YEAR(S) 0 MONTH(S)

RATE OF RETURN ON INVESTMENT 44.68 % (After tax)

FIGURE 6.0-3 NON-FILM RADIOGRAPHY WITH COMPUTER-AIDED INSPECTION

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 REAL TIME X-RAY

7.1.1 EQUIPMENT

The recommended viewing system consists of a high energy X-ray source, a selection of fluorescent screens, an isocon camera, and a selection of lenses. A part manipulation table and remote control capability must be provided to realize the advantages of real time radiography. If computer-aided inspection is to be implemented, then computer control of part positioning is required. The best image storage and retrieval medium is digital magnetic tape for systems which include a computer (for either image processing or computer-aided inspection). Otherwise, a high quality video tape system is satisfactory.

7.1.2 APPLICATIONS

Real time X-ray can easily be applied to assembly configuration inspections of large, complex parts. The assembly verification of the ROLAND missile can be performed by non-film radiography for 80% less cost than by film methods. Other applications, such as inspection of castings and welds, require higher resolution than the present system can provide.

7.2 IMAGE PROCESSING

The most useful image processing technique is contrast modification. Expanding the range of intensities will improve virtually any real time image. Edge enhancement methods emphasize details in some of the inspection areas, and the preferred type of edge enhancement depends upon the orientation of the detail. Gray level slicing is an effective way to determine the parameters for contrast modification. The pseudocolor operation is not particularly useful for this application.

The image processing techniques were applied to each ROLAND missile inspection point to determine the optimum sequence for assembly verification of the missile. Although there were no critical areas that could not be seen in real time, image processing did improve the quality of the images. For applications in which image processing allows the operator to see a detail that can not be seen in real time, then image processing is a necessary part of the non-film X-ray system.

7.3 COMPUTER-AIDED INSPECTION

The computer-aided inspection scheme saves time by positioning the part and performing the image processing sequence automatically. It also may be used for data base management of records and storage and retrieval of images. This type of automation is cost-effective when a computer is required for the image processing, and when working with high volume production.

7.4 ACCOMPLISHMENTS AND RECOMMENDATIONS FOR FUTURE WORK

This project has produced a system that is capable of meeting the inspection requirements for assembly verification of large, complex parts. Real time X-ray will be implemented for inspection of the ROLAND missile propulsion unit. Cost savings of $1.1 million per 10,000 missiles could be realized.

Future efforts should be directed toward expanding the applicability of non-film radiography. Assembly of a real time system with sufficient resolution to inspect castings and welds should be accomplished expeditiously. Another possible application is evaluation of composites. Further development of non-film X-ray could lead to the elimination of most film-based radiography. The potential cost benefits of replacement of film radiography are so significant that development continuation is strongly recommended to achieve this objective.

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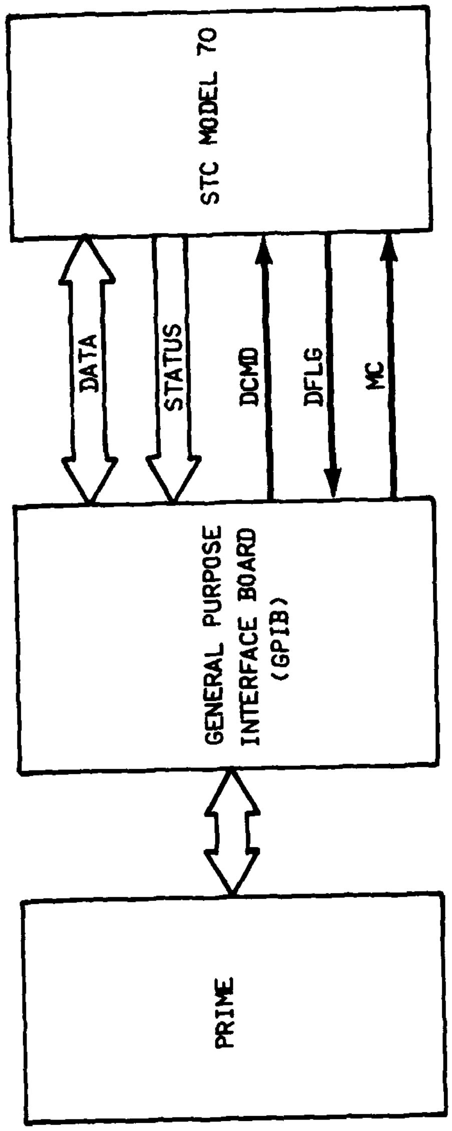
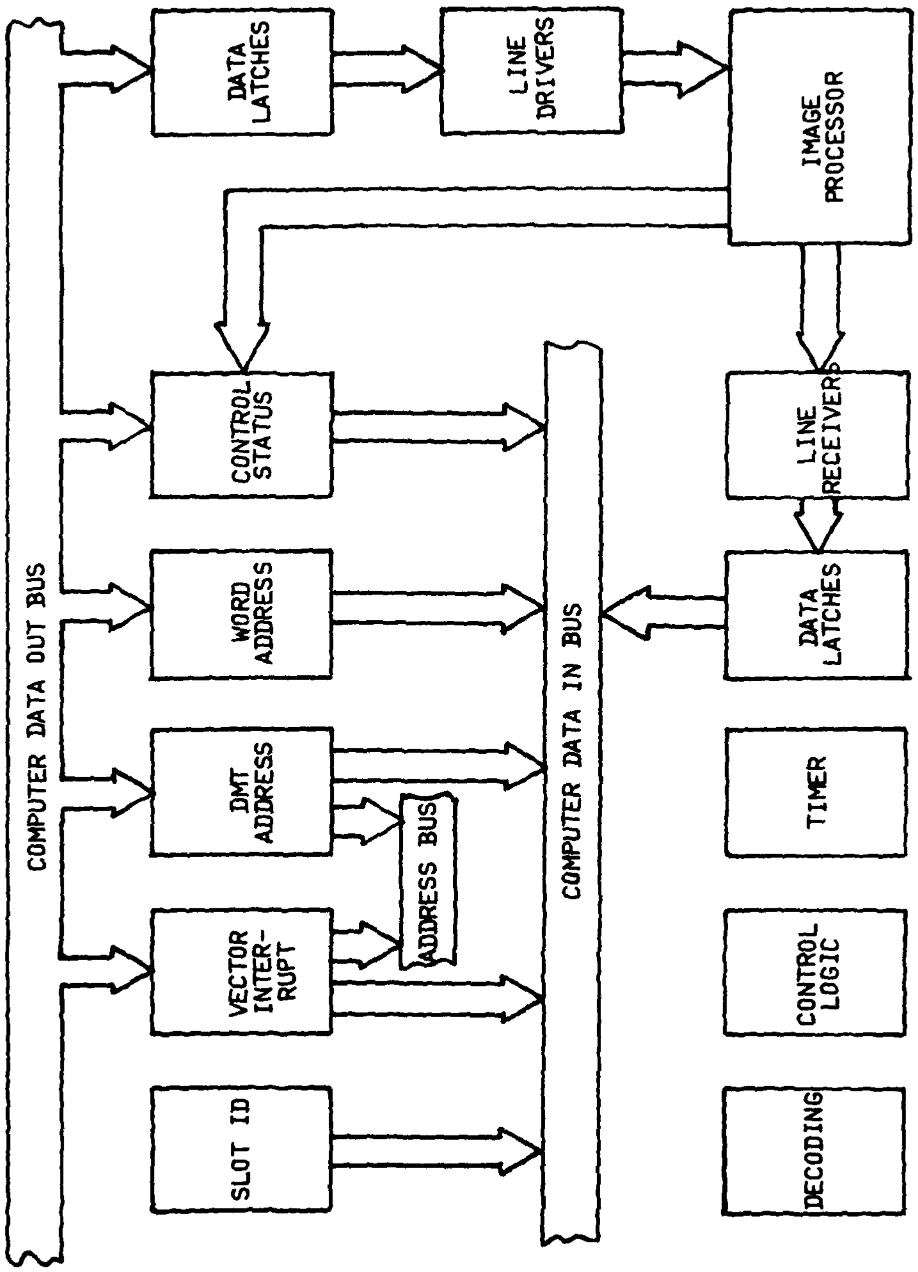
APPENDIX 1

STC M70 I/O SCHEMATICS

MODEL 70 CONTROL SYSTEM



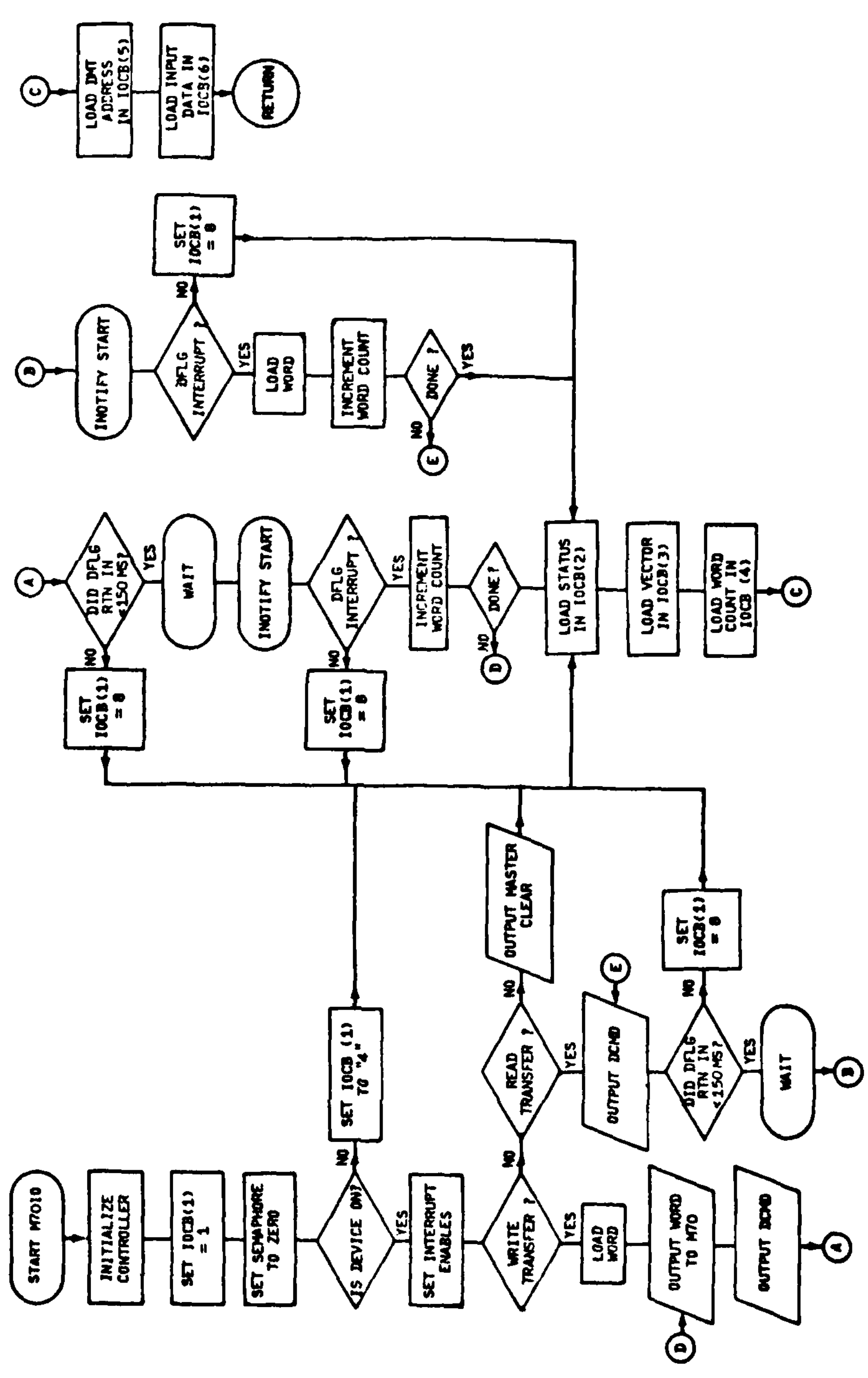
GENERAL PURPOSE INTERFACE BOARD (GPIB)



APPENDIX 2

IMAGE PROCESSOR SOFTWARE, LOGIC AND CODE

M7010 - COMPUTER-PROCESSOR COMMUNICATION



```
* M70IO: MODEL 70 IO DRIVER
*
*    ***************************************************************
*    *                                                             *
*    *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
*    *          VERSION 1.0     JUNE 1,1980                        *
*    *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
*    *                                                             *
*    ***************************************************************
*
* M70IO   11FEB1980   11:00
*CALL M70IO(IOCB,FUNC,BUFFER,COUNT)
*
*      IOCB IS AN INTEGER ARRAY, WHERE :
*
*           IOCB(1) = AN INTEGER TO RETURN TO CALLING PROGRAM
*
*              IOCB(1)=1  IS A GOOD RETURN
*              IOCB(1)=2  IS NO READY SIGNAL ON GPIB
*              IOCB(1)=4  IS NO 5 VOLTS FROM MODEL 70
*              IOCB(1)=8  IS INTERRUPT HAS OCCURRED
*
*           IOCB(2) = THE INTERRUPT ENABLES
*              BIT  1=
*              BIT  2=
*              BIT  3=
*              BIT  4=
*              BIT  5=
*              BIT  6=
*              BIT  7=
*              BIT  8=
*
*              BIT  9=  DONE
*              BIT 10=  BUTTONPRESSED
*              BIT 11=  CURSOR MOVED
*              BIT 12=  VERTICAL INTERVAL
*              BIT 13=  THING COUNT=0
*              BIT 14=  ATTENTION
*              BIT 15=  TIMEOUT
*              BIT 16=  +5VOLTS FROM M70
*
*           IOCB(3) = VECTOR ADDRESS
*           IOCB(4) = WORD COUNT
*           IOCB(5) = DMT ADDRESS
*           IOCB(6) =
*
*      FUNC IS THE OPERATION TO BE PERFORMED
*
*           FUNC     = 0 IMPLIES WRITE  (COMPUTER --> M70)
*           FUNC     = 1 IMPLIES READ   (M70 -->COMPUTER )
*           FUNC     = 2 IMPLIES M70 MASTER CLEAR
*
*      BUFFER IS AN INTERGER ARRAY THAT EITHER CONTAINS THE HEADER TO BE
*              TRANSFERRED OR CONTAINS THE DATA TO OR FROM THE M70
*
*      COUNT IS AN INTEGER REPRESENTING THE NUMBER OF WORDS TO BE SENT OR
*              RECEIVED BY THE M70
*
*
*
*
*
*
        ENT   M70IO,M70ECB
        EXT   SP2SEM
        SEG
        D64V
M70IO   EQU   *
        ARGT
*
*INITIALIZE THE CONTROLLER
*
        OCP   '1760      CLEAR ALL THE REGISTERS ON THE BOARD
```

```
*
*
          OCP   '260        ENABLE INTERRUPTS
*LOAD THE INTERRUPT VECTOR
*
SP2INT    XAC   SP2INT      GET ADDRESS OF INTERRUPT IN SEG4
          LDA   SP2INT
          OTA   '1660       OUTPUT IT TO VECTOR ADDRESS REGISTER
          BCNE  ERR
          LDL   =0
          STL   SP2SEM
*
*SET IOCB(1) EQUAL TO 1
*
          LT
          STA   IOCB,*1
*
*CHECK IF DEVICE IS ON
*
          SKS   '60
          BCNE  DOFF        BRANCH TO DOFF IF DEVICE HAS NO +5 VOLTS
*
*SET UP INTERRUPT ENABLES
*
          LDX   =1
          LDA   IOCB,*1     LOAD IOCB(2)
          OTA   '560        OUTPUT IT TO CONTROL/STATUS REG
          BCNE  ERR
          STA   CSREG
*
*DETERMINE IF READ OR WRITE  (IF NEITHER THEN MASTER CLEAR)
*
          LDA   FUNC,*      LOAD FUNC
          STA FNTN
          BEQ   WRIT        BRANCH TO WRIT IF A = 0
          ARS   1
          BEQ   READ        BRANCH TO READ IF A = 1
          JMP   MC          OTHERWISE JUMP TO MASTER CLEAR
*
*WRITE OPERATION  (COMPUTER TO M70)
*
WRIT      LDA   COUNT,*     LOAD NUMBER OF WORDS TO TRANSFER
          STA   INCT
          TCA               2'S COMPLEMENT
          STA   WDCTM
          OTA   '360        OUTPUT TO WC REGISTER
          BCNE  ERR
          LDX   =0          LOAD INDEX REGISTER
          STX   XSAV
WLOOP     LDA   BUFFER,*1    LOAD NEXT WORD IN BUFFER
          INH
          OTA   '1060       OUTPUT DATA
          BCNE  ERR
          WAIT  SP2SEM      SUSPEND
          SKS   '1060       SKIP IF DFLG IS HIGH
          BCNE  INTERR
          LDX   XSAV
          LDA   WDCTM
          A1A               ADD 1 TO WDCTM
          STA   WDCTM
          IRX               INCREMENT INDEX
          STX   XSAV
          BLT   WLOOP       BRANCH IF WDCTM < 0
          JMP   DONE
*
*READ OPERATION  (M70 TO COMPUTER)
*
READ      LDA   COUNT,*     LOAD NUMBER OF WORDS TO READ
          STA   INCT
          TCA               2'S COMPLEMENT
          STA   WDCTM
          OTA   '360        OUTPUT TO WORD COUNT REGISTER
```

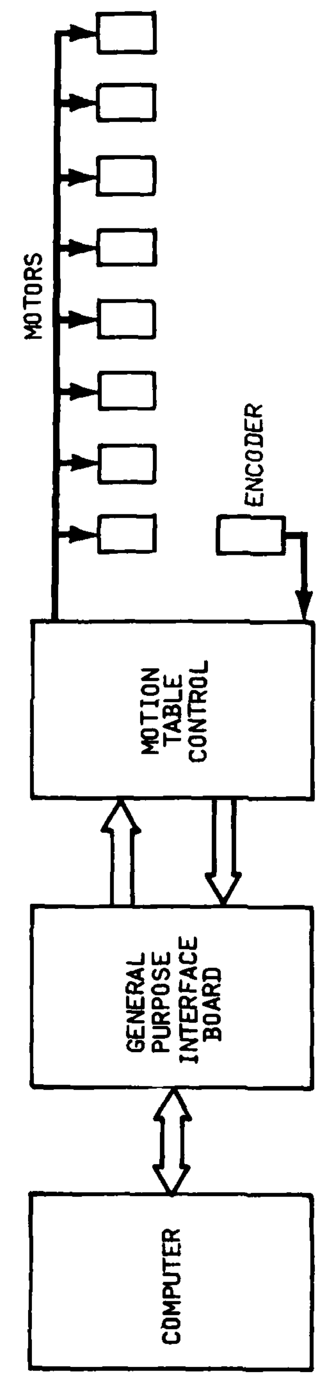
```
          BCNE ERR
          LDX  =0          SET INDEX =0
          STX  XSAV
RLOOP     EQU  *
          INH
          OCP  '1060       SEND DCMD
          WAIT SP2SEM      SUSPEND
          SKS   '1060      SKIP IF DFLG IS HIGH
          BCNE INTERR      SOMETHING ELSE CAUSED INTERRUPT
          INA  '1060       INPUT DATA
          BCNE ERR
          LDX XSAV
          STA  BUFFER,*1    STORE IT IN BUFFER
          LDA  WDCTM
          A1A              ADD 1 TO WDCTM
          STA  WDCTM
          IRX              INCREMENT INDEX
          STX XSAV
          BLT  RLOOP       BRANCH IF WDCTM < 0
          JMP  DONE
*
*MASTER CLEAR OPERATION
*
MC        EQU  *
          OCP  '1160       OUTPUT MASTER CLEAR TO M70
          JMP  DONE
*
*DONE ROUTINE
*
DONE      EQU *
             OCP  '460  DISABLE INTERRUPTS
          LDX  =1
          INA  '560        INPUT STATUS REGISTER
          BCNE ERR
          STA  IOCB,*1        IOCB(2)
          IRX
          INA  '1560       INPUT VECTOR ADDRESS
          BCNE ERR
          STA  IOCB,*1        IOCB(3)
          IRX
          INA  '360        INPUT WORD COUNT
          BCNE ERR
          TCA              2'S COMPLEMENT
          STA  IOCB,*1        IOCB(4)
          IRX
          INA  '160        INPUT DMT ADDRESS
          BCNE ERR
          STA  IOCB,*1        IOCB(5)
          IRX
          INA  '1060        INPUT INPUT DATA
          BCNE ERR
          STA  IOCB,*1        IOCB(6)
*
*
          PRTN
DOFF      EQU  *           DEVICE NOT ON!!!!!!
          LDX  =0
          LDA  =4          SET FLAG TO 4
          STA  IOCB,*1     PUT IT IN IOCB(1)
          JMP  DONE
*
*THIS ERROR MEANS NO READY SIGNAL ON GPIB FOR INA OR OTA
*
ERR       EQU  *
          LDX  =0
          LDA  =2          SET FLAG TO 2
          STA  IOCB,*1     PUT IT IN IOCB(1)
          PRTN
*
*INTERRUPT ERROR ROUTINE
*
INTERR    EQU  *           AN INTERRUPT HAS OCCURED
          LDX  =0
```

```
         LDA   =8          SET FLAG TO 8
         STA   IOCB,*1     PUT IT IN IOCB(1)
         JMP   DONE
*
*DATA DEFINITION
*
WDCTM     0                 TWOS COMPLEMENT OF COUNT
CSREG     0
FNTN      0
INCT      0
XSAV      0
         DYNM IOCB(3),FUNC(3),BUFFER(3),COUNT(3)
*
         LINK
M70ECB   ECB   M70IO,,IOCB,4
         END
```

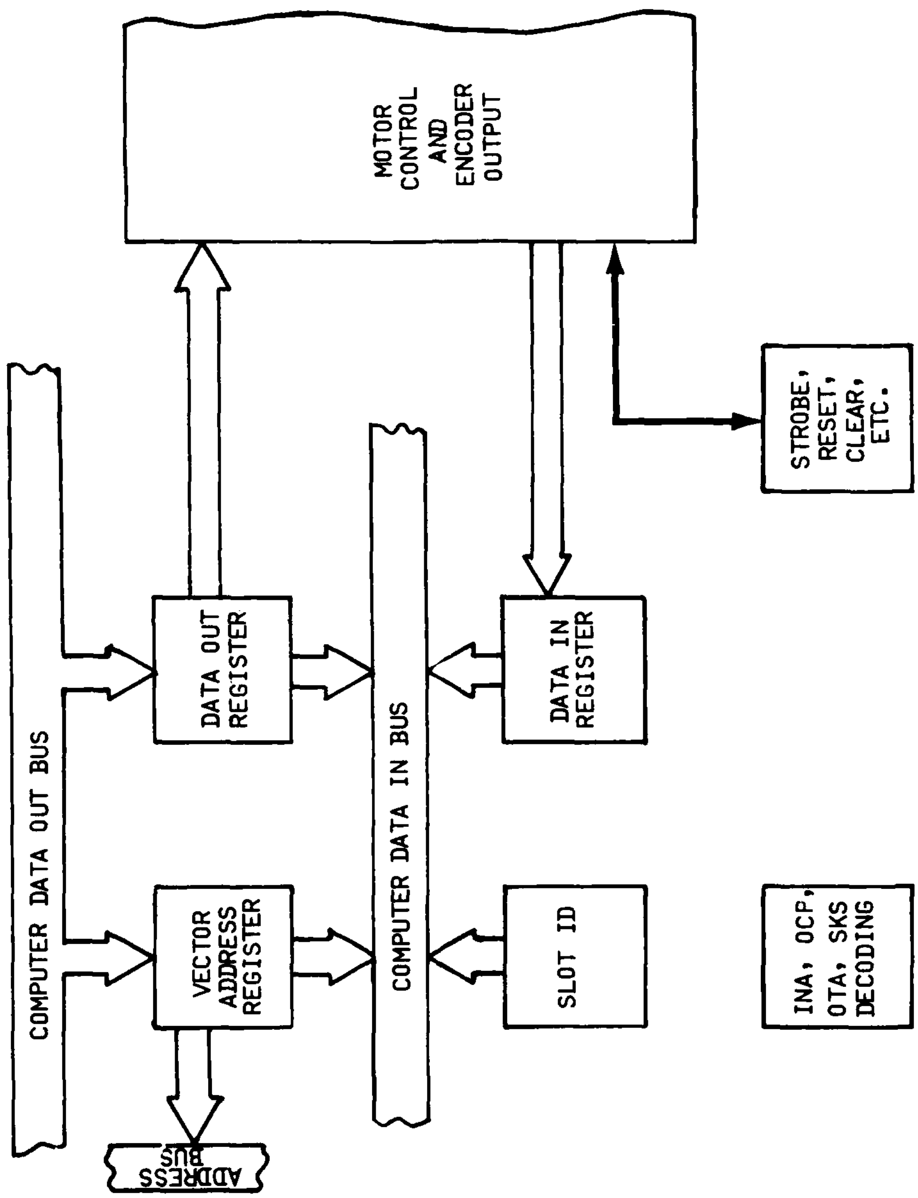
APPENDIX 3

MOTOR CONTROL SCHEMATICS

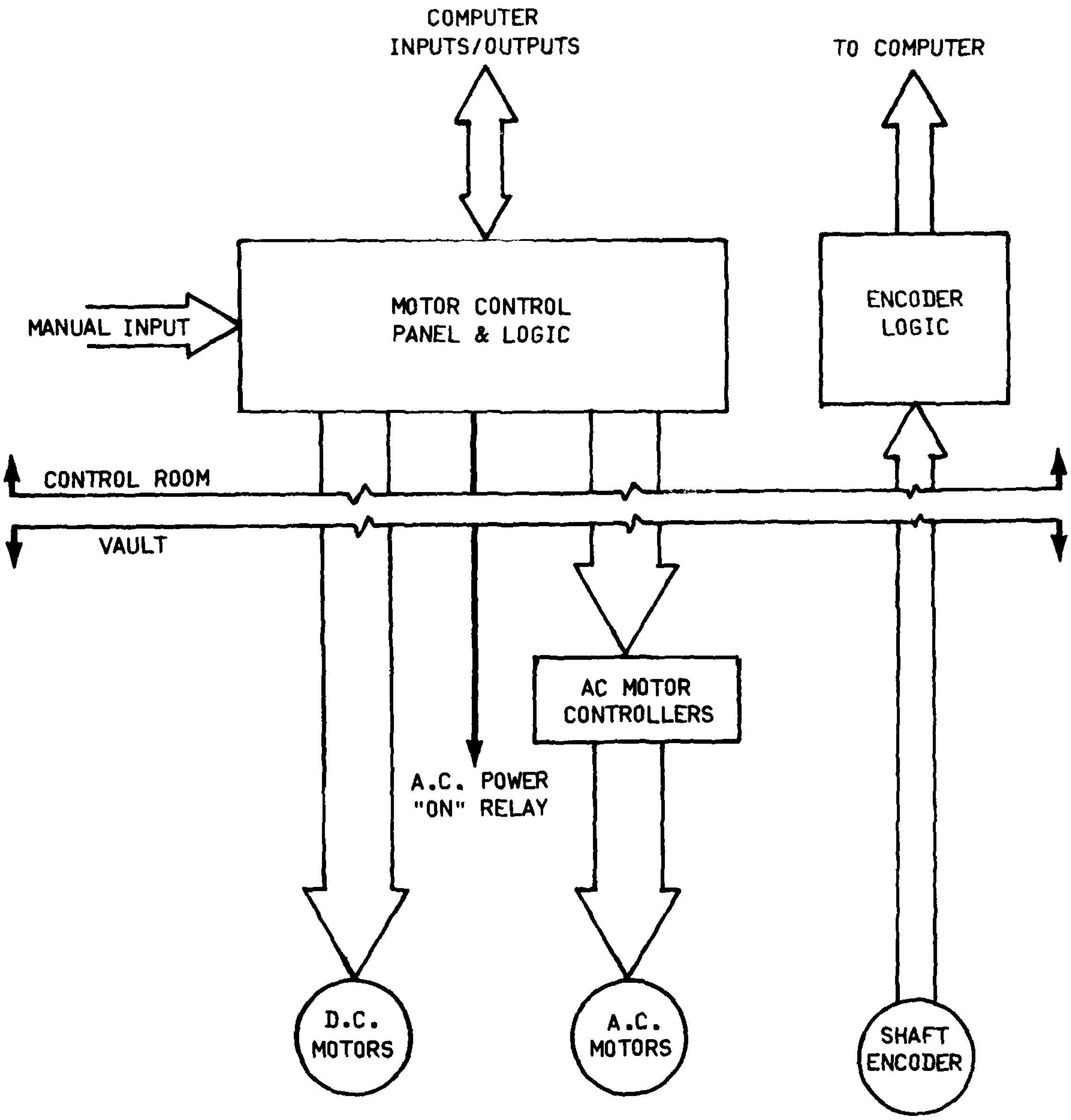
MOTION CONTROL SYSTEM



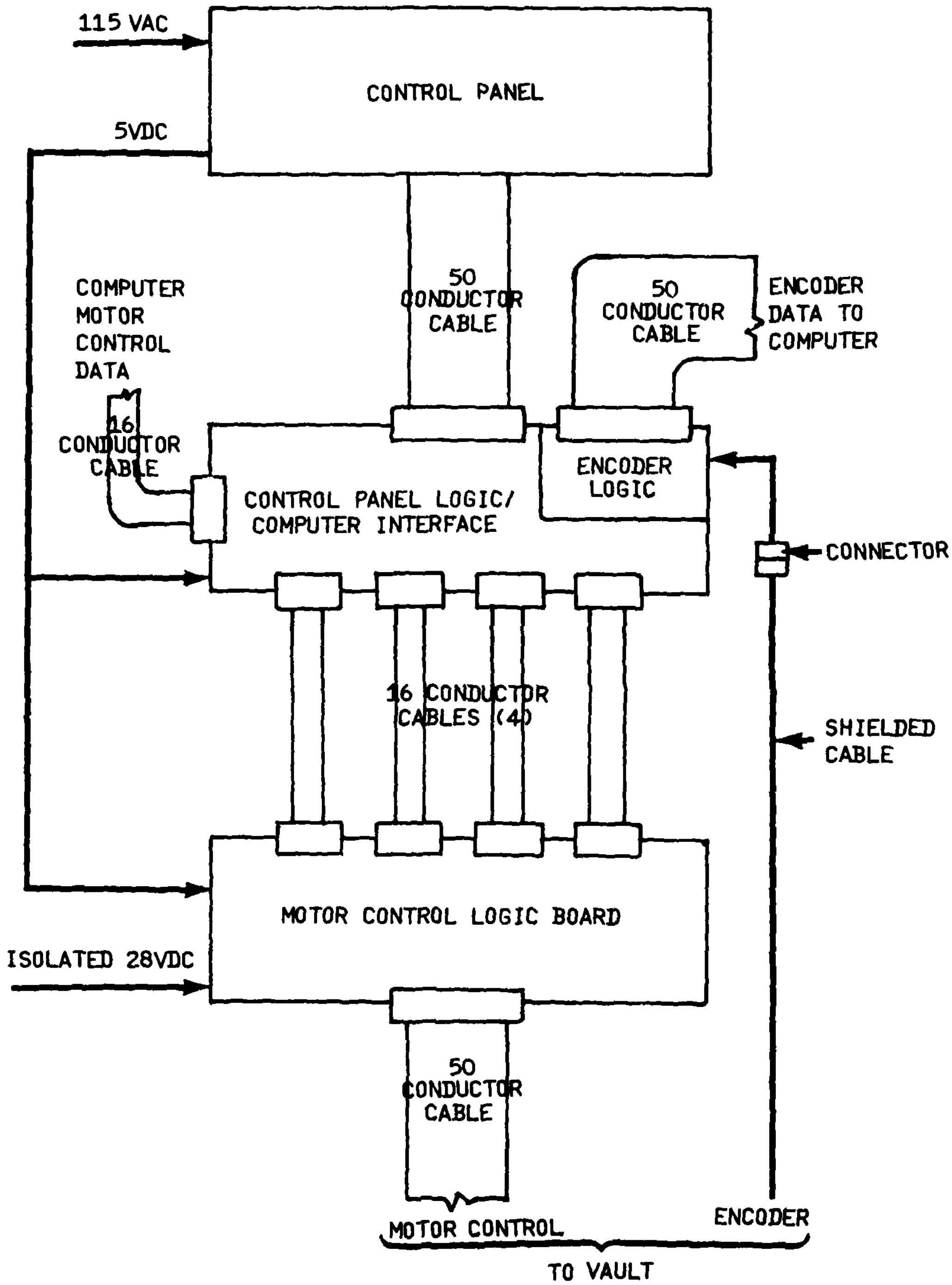
MOTION CONTROL INTERFACE BOARD



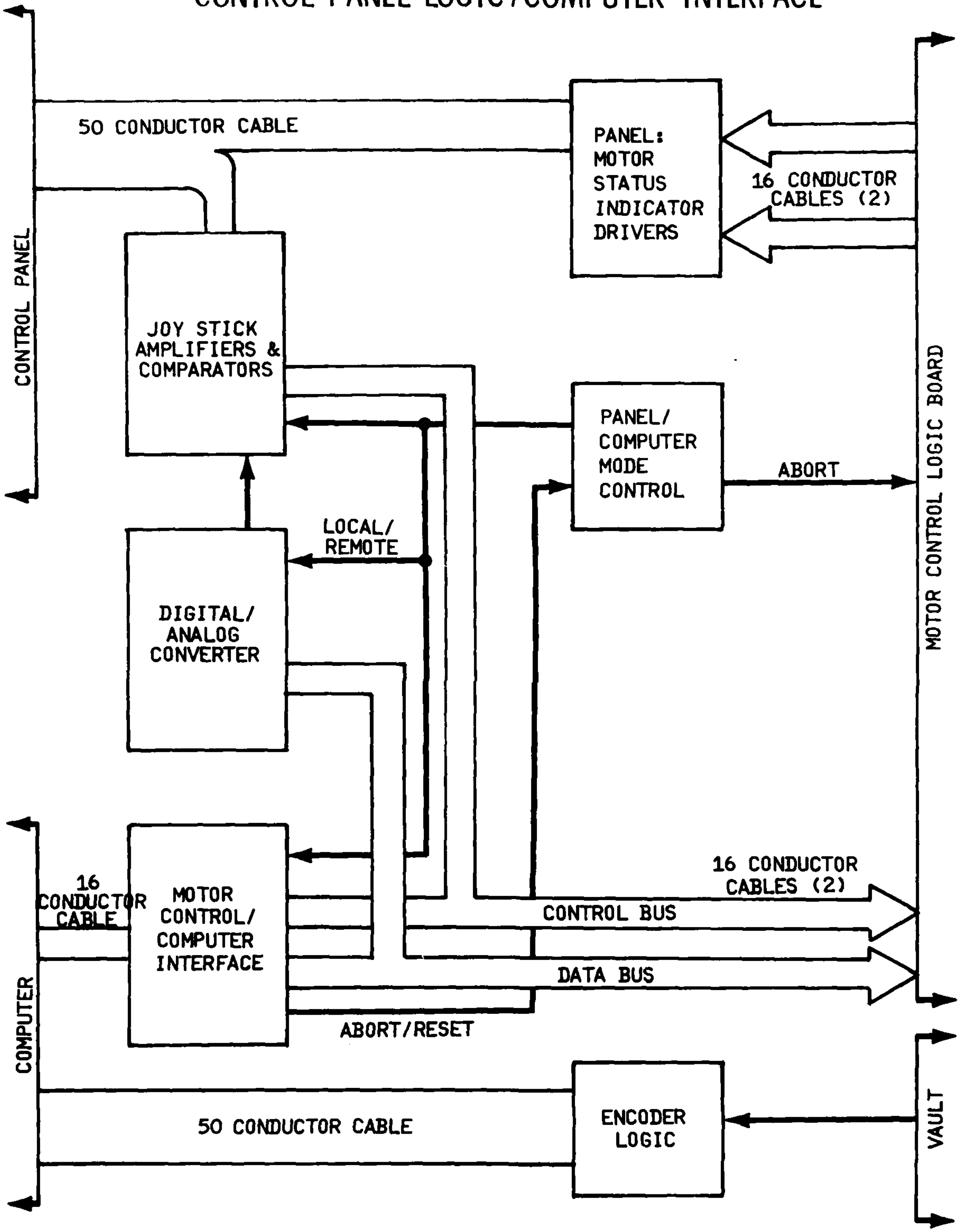
MOTOR CONTROL SYSTEM



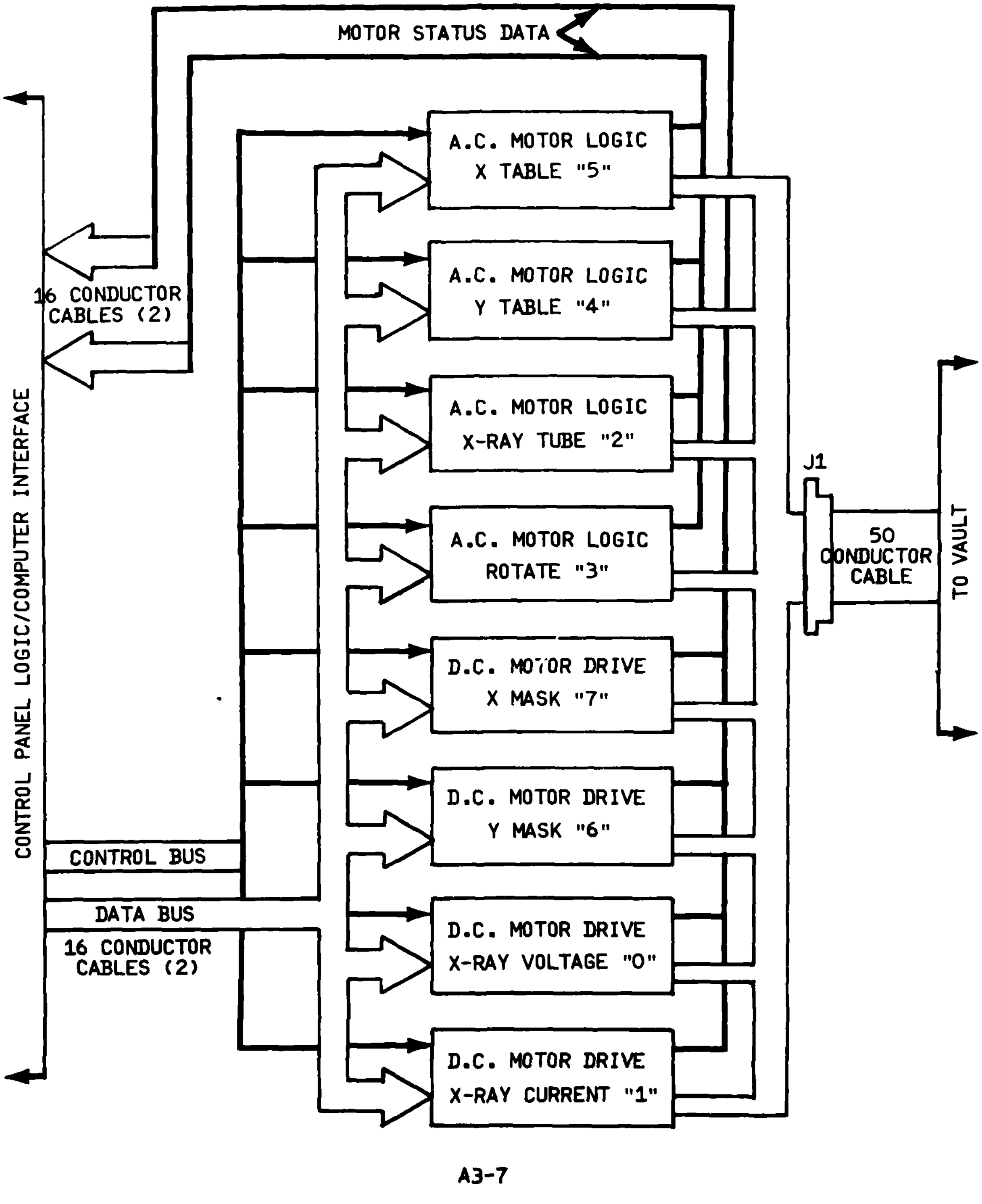
MOTOR CONTROL PANEL & LOGIC



CONTROL PANEL LOGIC/COMPUTER INTERFACE



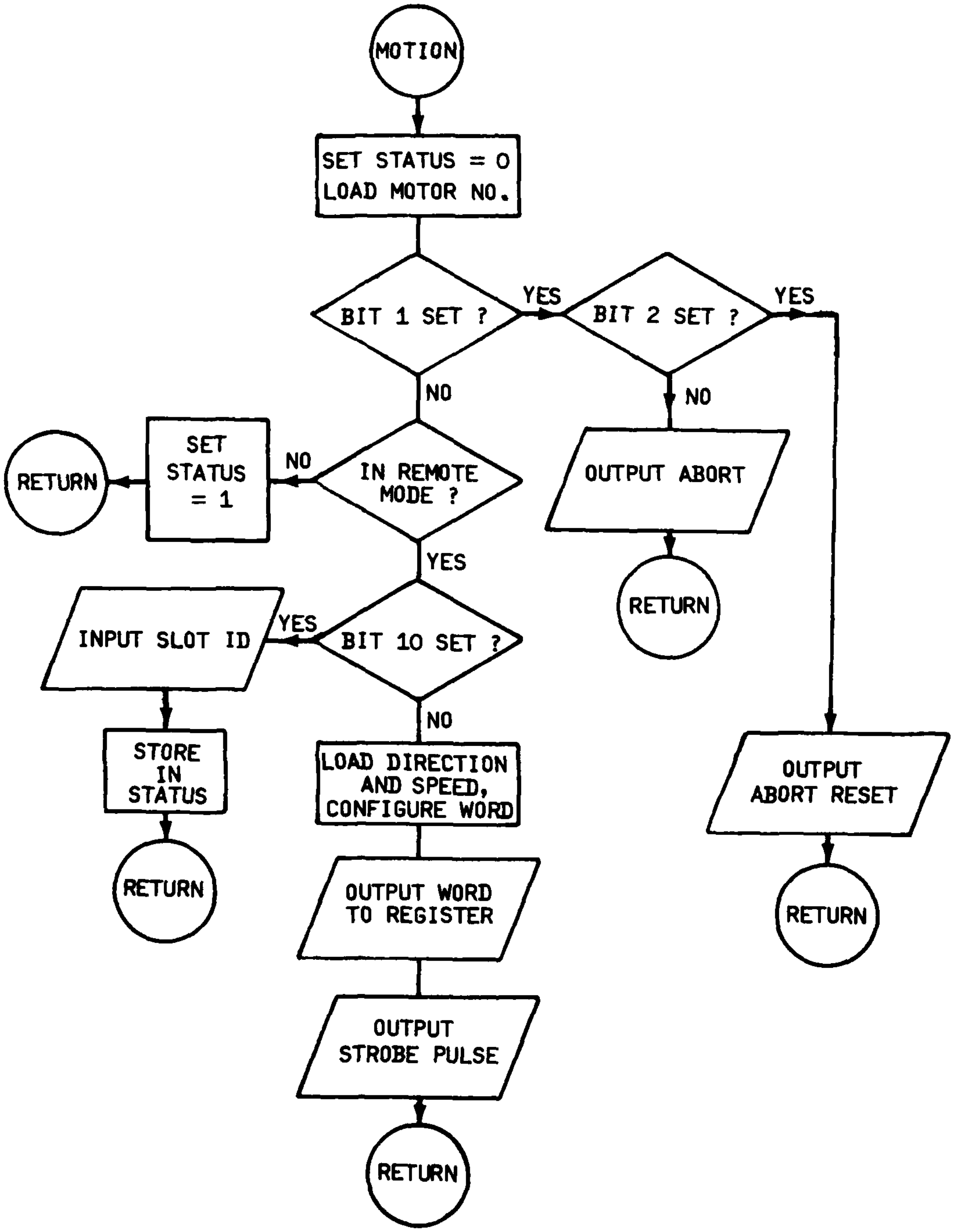
MOTOR CONTROL LOGIC BOARD



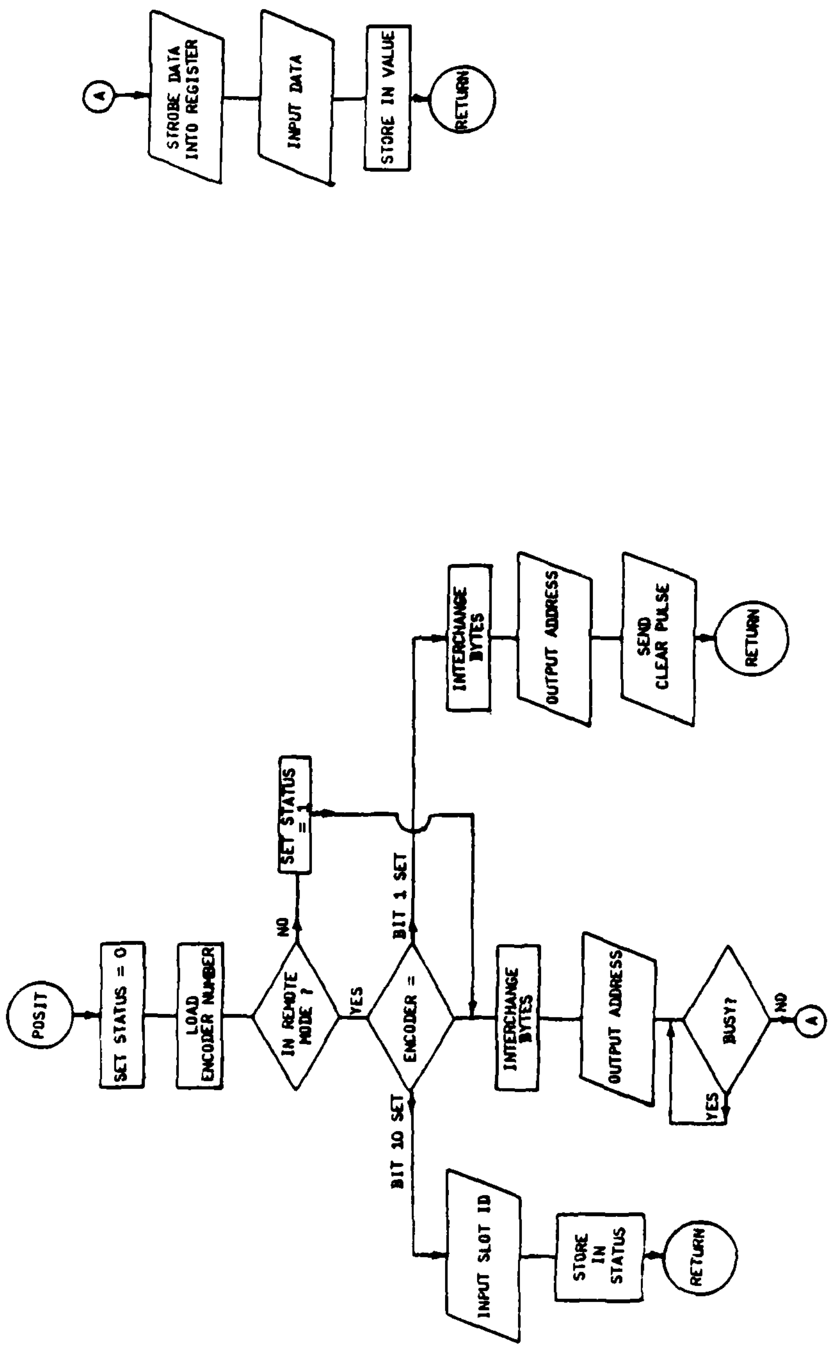
APPENDIX 4

MOTOR CONTROL SOFTWARE, LOGIC AND CODE

MOTION - MOTOR(S) CONTROL



POSIT - READ ENCODER POSITION



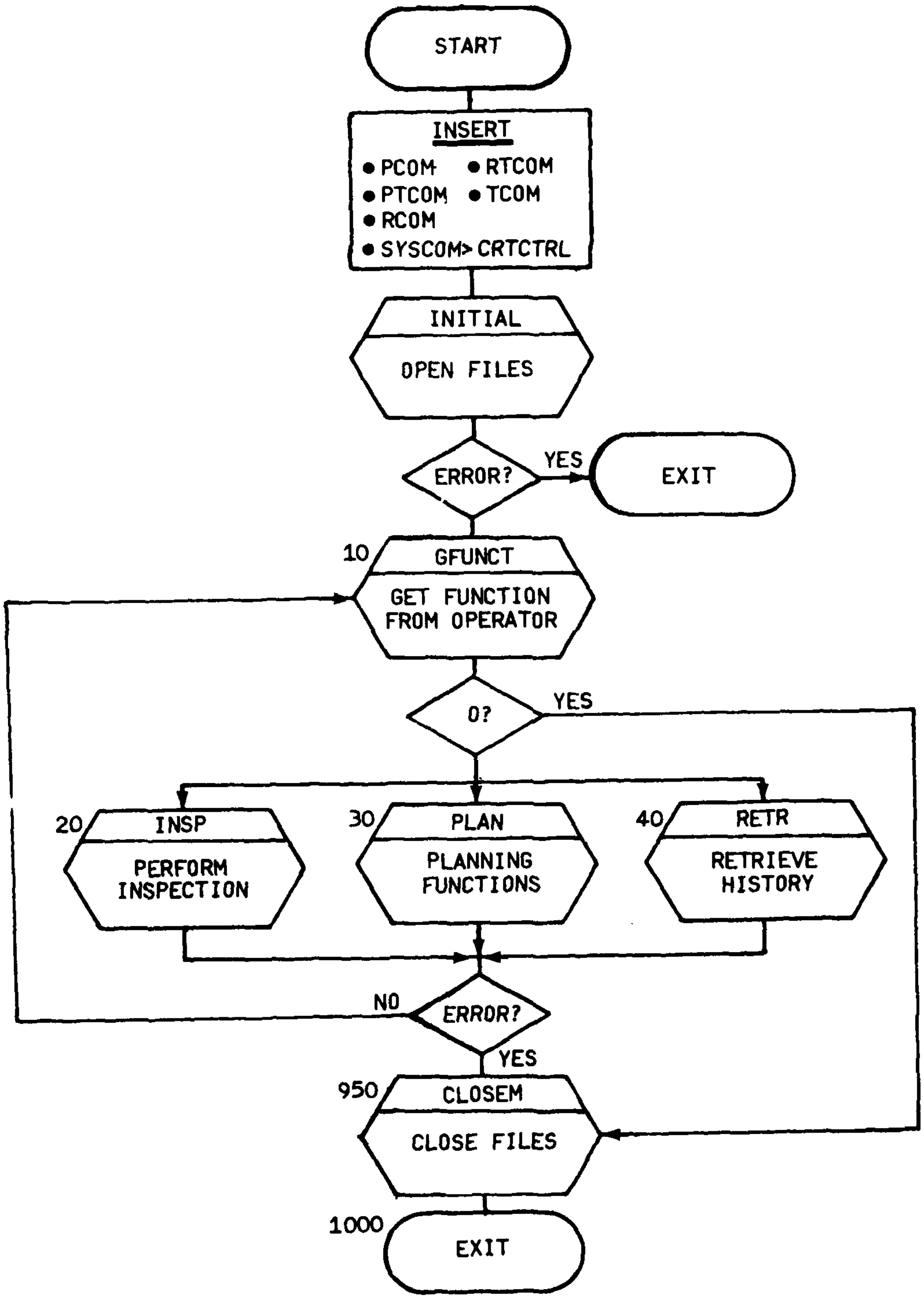
```
* MOTION: ENTRY TO MOTOR DRIVER IN SYSTEM
*
*
*    ****************************************************************
*    *                                                              *
*    *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
*    *          VERSION 1.0     JUNE 1,1980                         *
*    *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
*    *                                                              *
*    ****************************************************************
*
*      CALL MOTION(MOTOR#,DIRECTION,SPEED,STATUS)
*
*      MOTOR#= 0 TO 7
*
*              IF BIT 1 SET THEN ISSUE ABORT
*              IF BIT 1 AND BIT 2 SET THEN ISSUE ABORT RESET
*              :100  IS SLOT ID INQUERY
*
*      DIRECTION
*
*              0 =ONE WAY
*
*              1 =THE OTHER WAY
*
*      SPEED
*
*              0 THRU :177   (MUST BE >= :20 FOR MOTOR TO GO ON)
*
*      STATUS
*
*              0= OK
*              1= NOT IN REMOTE
*              2= NO READY SIGNAL ON GPIB
*
*
*    *CALLED BY: POSINT, MOTOR                                      *
*    *FUNCTION: MOVE A MOTOR                                         *
*    *WRITTEN IN ASSEMBLY LANGUAGE                                   *
*
     DYNT  MOTION
     SEG
     END
```

```
*     POSIT:   ENTRY FOR ENCODER READOUT
*
*    ***************************************************************
*    *                                                             *
*    *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
*    *          VERSION 1.0     JUNE 1,1980                        *
*    *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
*    *                                                             *
*    ***************************************************************
*
* CALL POSIT(ENCODER#,VALUE,STATUS)     29MAY1980
*
*        ENCODER#          0 TO 7 FOR THE MOTORS
*
*                          '100 IS REQUEST FOR SLOT ID, WHICH IS RETURNED
*                          IN STATUS
*
*                          IF BIT 1 (MSB) IS SET THEN CLEAR THE ENCODER
*
*        VALUE=            THE RETURNED VALUE FROM THE ENCODER
*                            (UNLESS A REQUEST WAS MADE FOR SLOT ID)
*
*
*        STATUS=           0 = A GOOD READ
*
*                          1 = NOT IN REMOTE MODE
*
*                          2 = NO READY SIGNAL ON GPIB
*
*    *CALLED BY: POSINT AND PIMG AND MOTOR                         *
*    *FUNCTION: READ POSITION OF ENCODER                           *
*    *WRITTEN IN ASSEMBLY LANGUAGE                                 *
*
      DYNT POSIT
      SEG
      END
```

APPENDIX 5

COMPUTER-AIDED INSPECTION SOFTWARE. LOGIC AND CODE

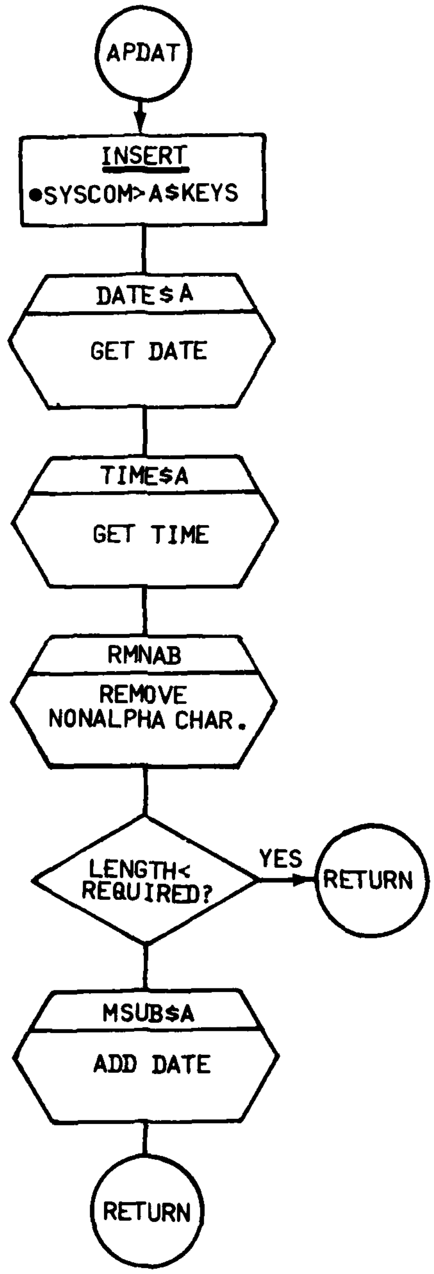
AI - AUTOMATED INSPECTION (TOP LEVEL)



APDAT - APPEND DATE TO KEYWORD

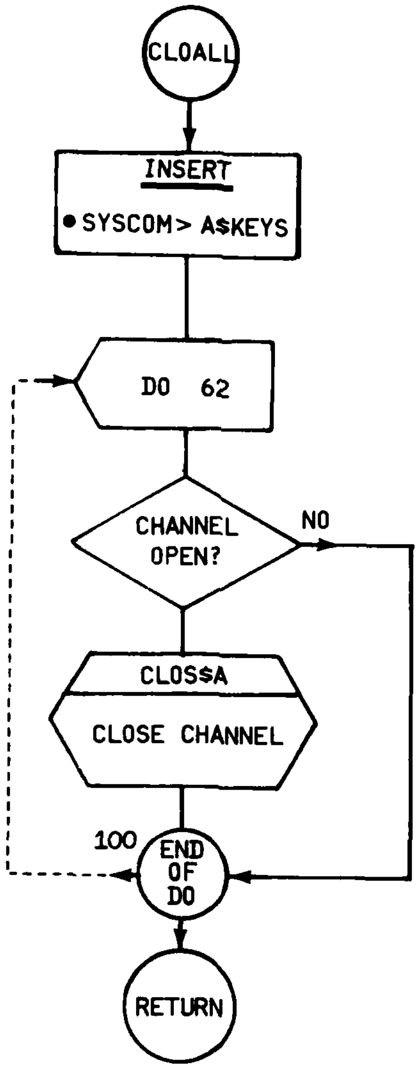
ARGUMENTS: 2

- STRING: KEY
- INTEGER: LENGTH



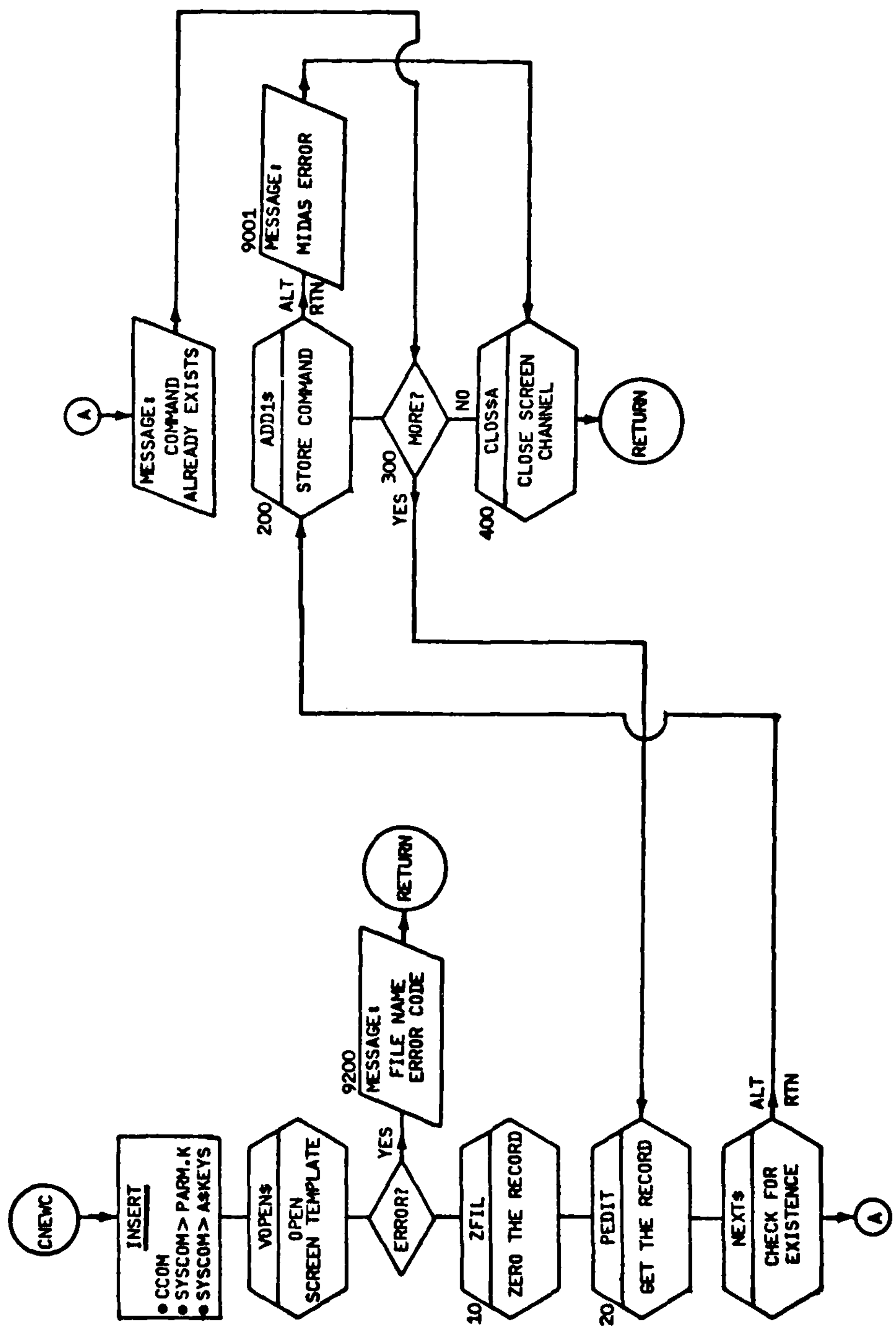
CLOALL - CLOSE ALL OPEN CHANNELS

ARGUMENTS: NONE



CNEWC - CREATE NEW IMAGE PROCESSOR COMMAND

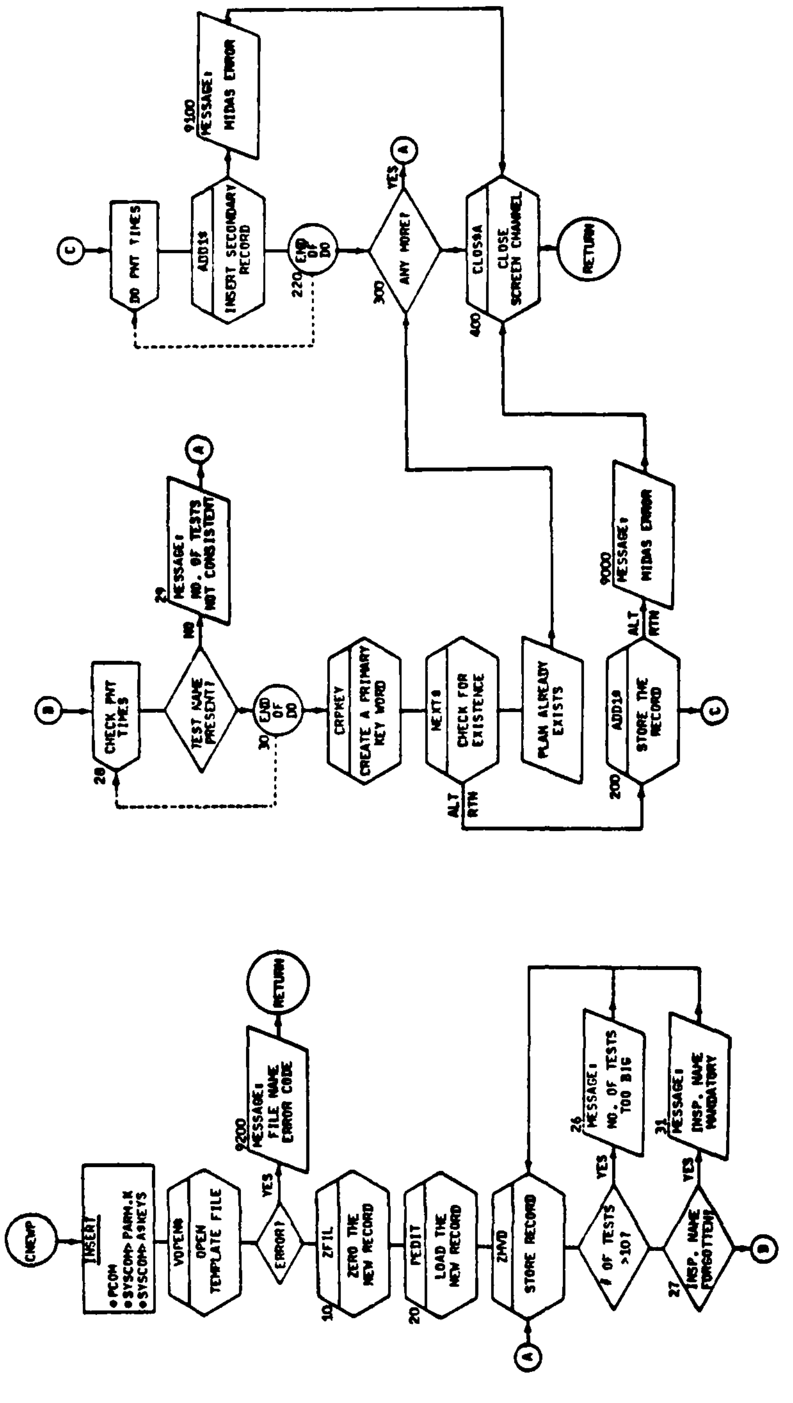
ARGUMENTS: 1
• INTEGER: ERROR



CNEWP - CREATE NEW PLAN

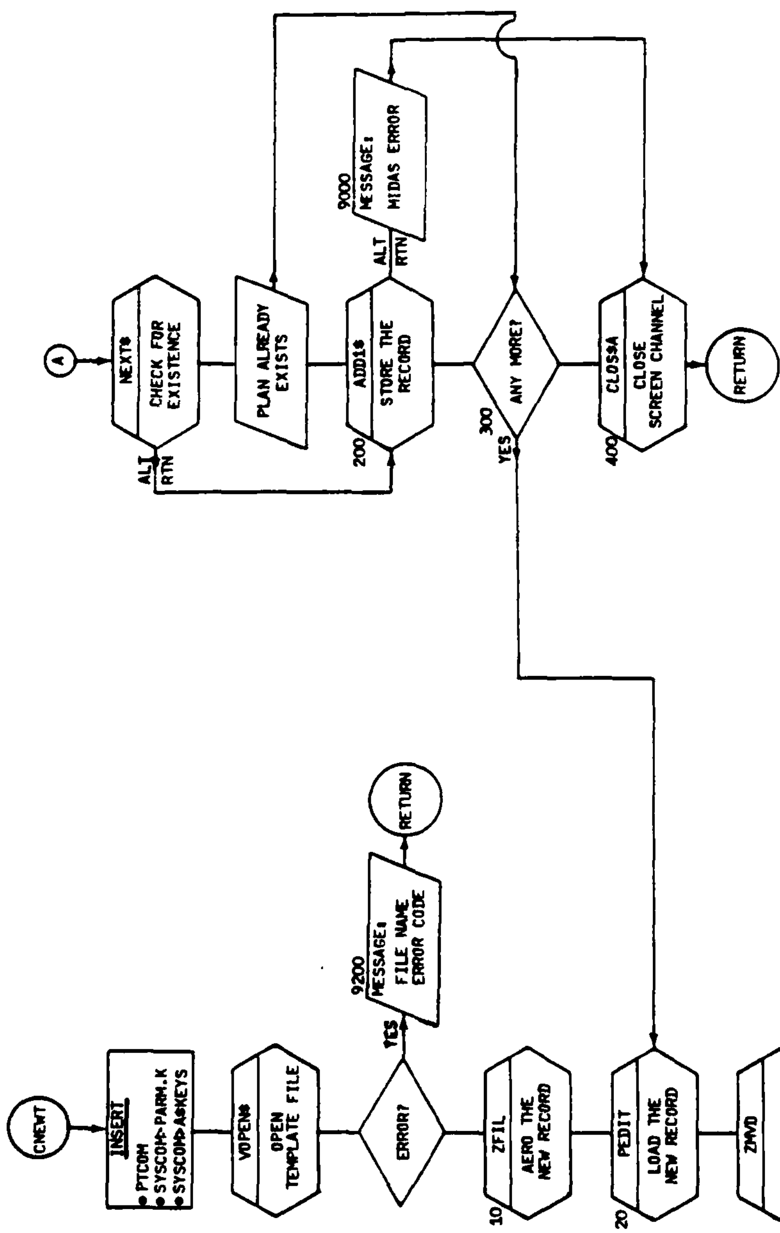
ARGUMENTS: 1

● INTEGER: ERROR



CNEWT - CREATE NEW TEST ENTRY

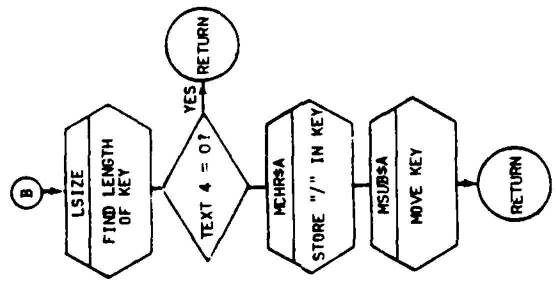
ARGUMENTS: 1
● INTEGER: ERROR

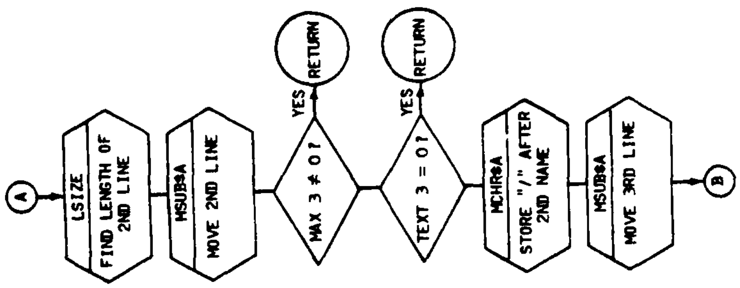


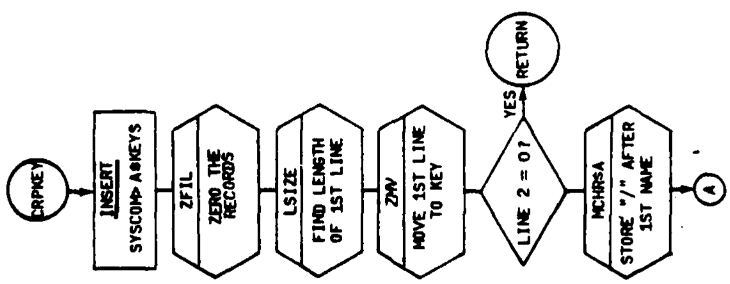
CRPKEY - CREATE PLAN KEYWORD

ARGUMENTS: 10

- STRING: 1ST LINE OF TEXT
- INTEGER: LENGTH OF 1ST LINE
- STRING: 2ND LINE OF TEXT
- INTEGER: LENGTH OF 2ND LINE
- STRING: 3RD LINE OF TEXT
- INTEGER: LENGTH OF 3RD LINE
- STRING: 4TH LINE OF TEXT
- INTEGER: LENGTH OF 4TH LINE
- STRING: KEYWORD
- INTEGER: LENGTH OF KEYWORD

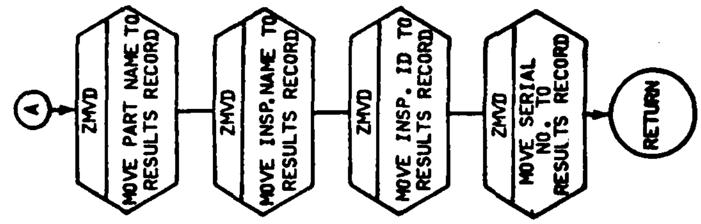


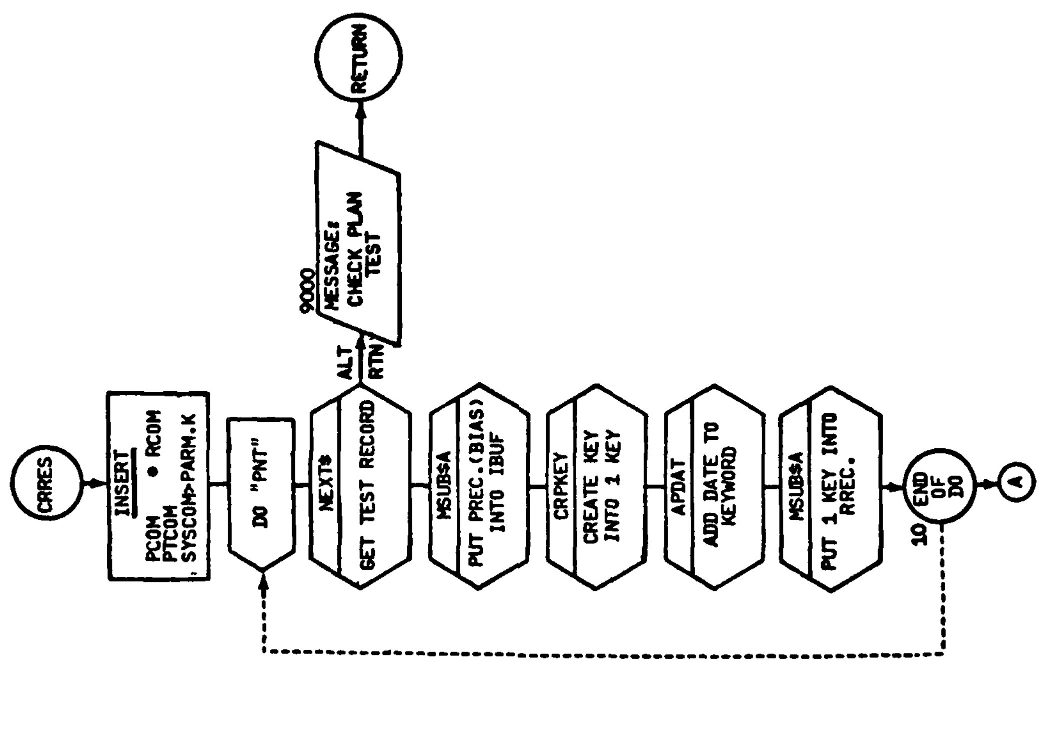




CRRES - CREATE RESULTS RECORD

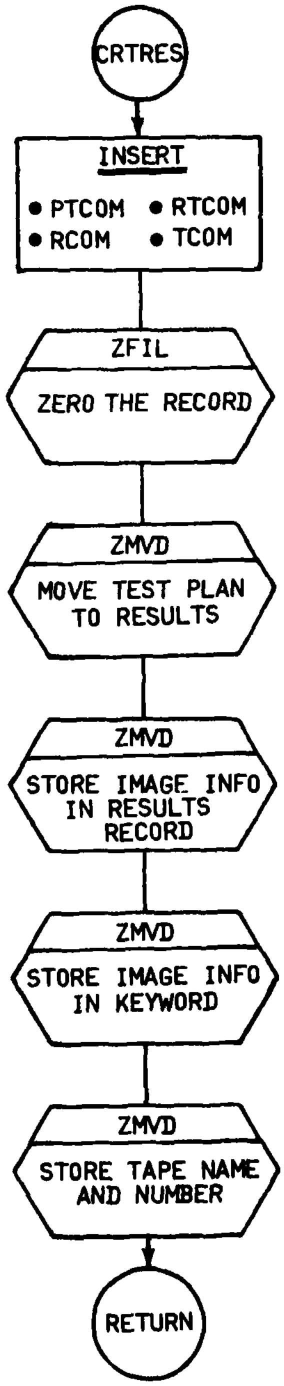
ARGUMENTS: 3
- STRING: SERIAL NUMBER
- STRING: INSPECTOR I.D.
- INTEGER: ERROR





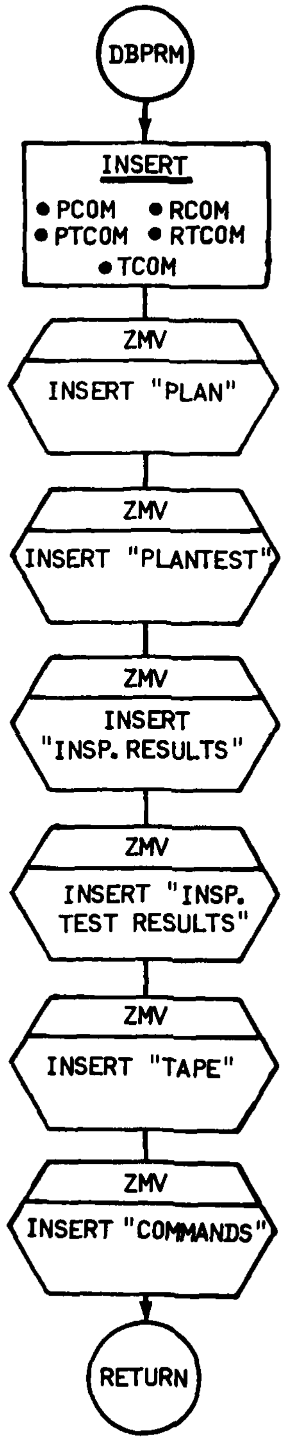
CRTRES - CREATE A TEST RESULTS RECORD

ARGUMENTS: 2
- INTEGER: TEST SEQUENCE NO.
- STRING: RESULTS KEYWORD



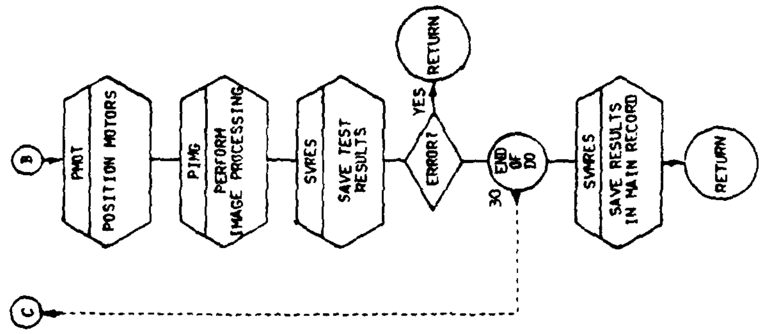
DBPRM - INSERT DATA BASE PARAMETERS

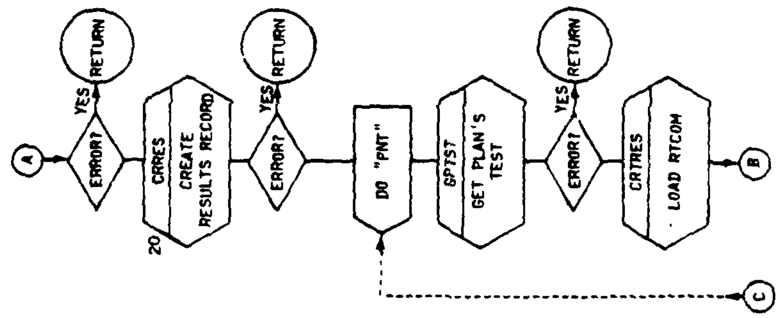
ARGUMENTS: NONE

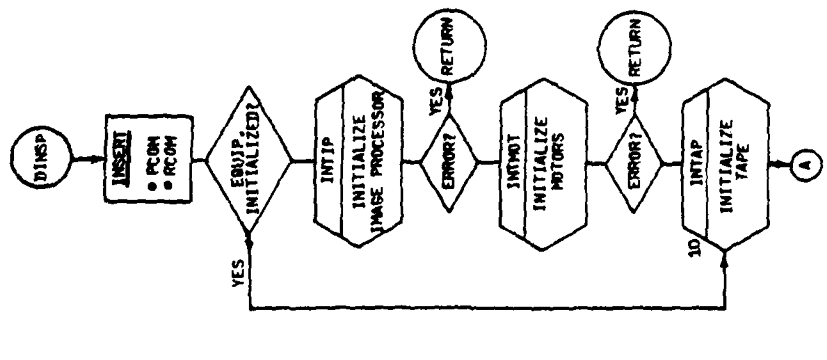


DINSP - DO THE INSPECTION PER PLAN

ARGUMENTS: 5
- STRING: INSPECTOR I.D.
- STRING: PART NUMBER
- STRING: TEST I.D.
- STRING: SERIAL NUMBER
- INTEGER: ERROR



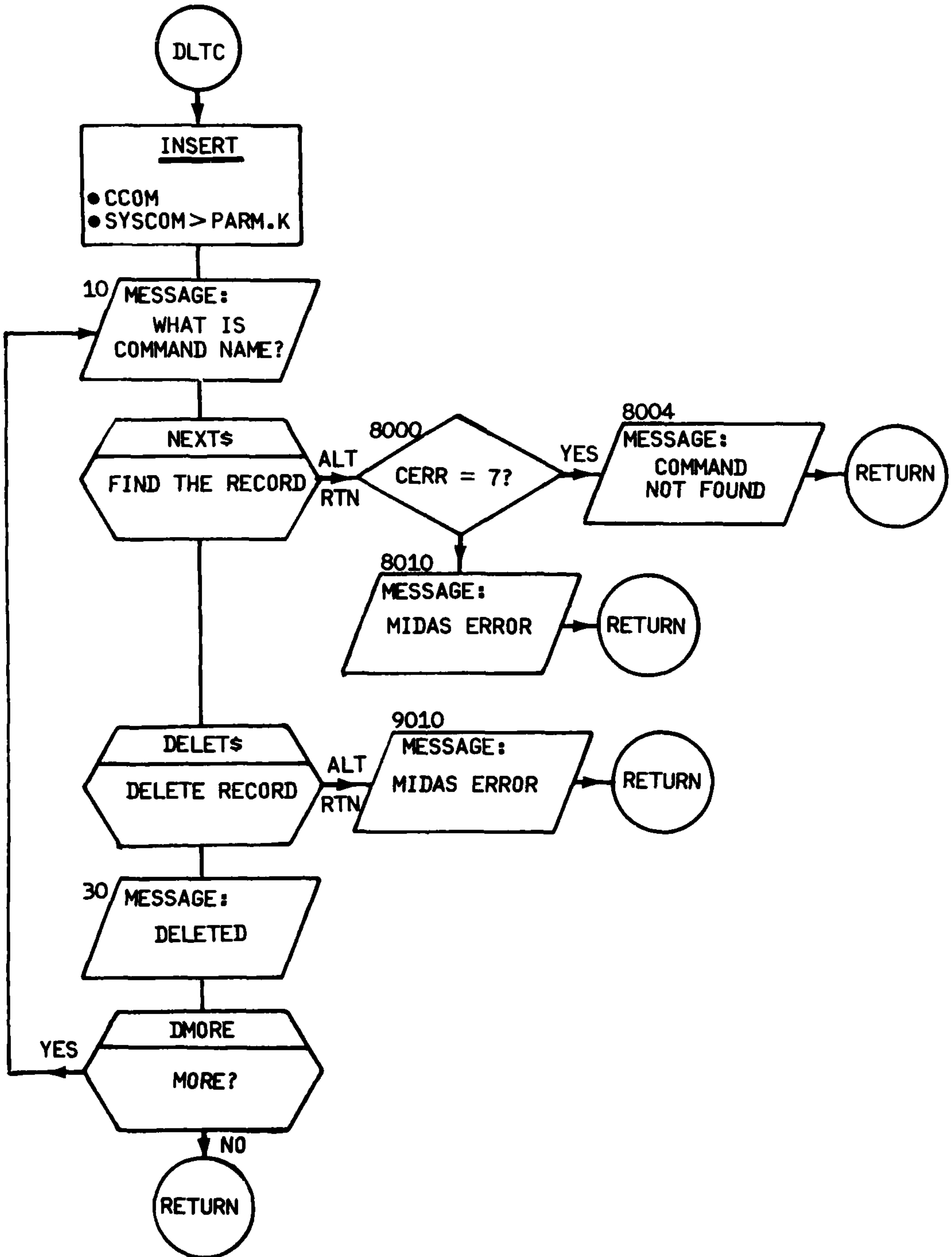




DLTC - DELETE IMAGE PROCESSOR COMMAND

ARGUMENTS: 1

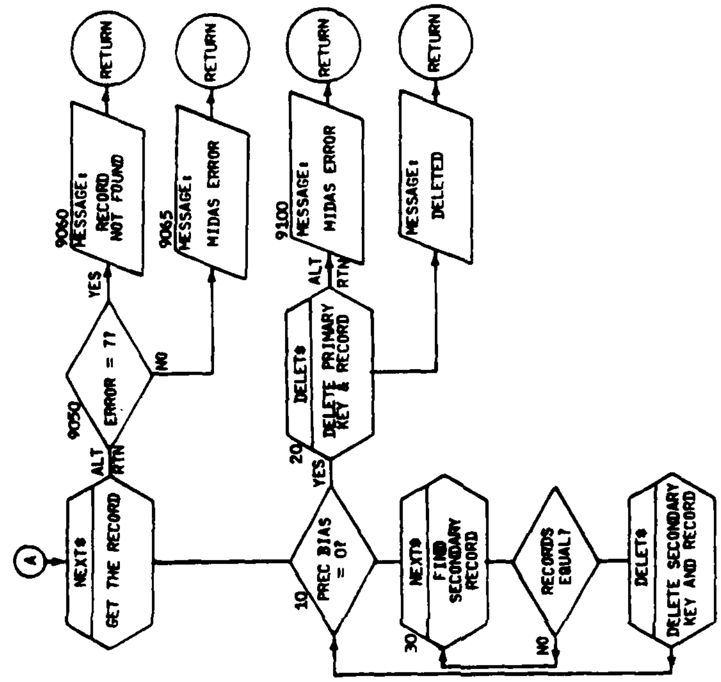
- INTEGER: ERROR

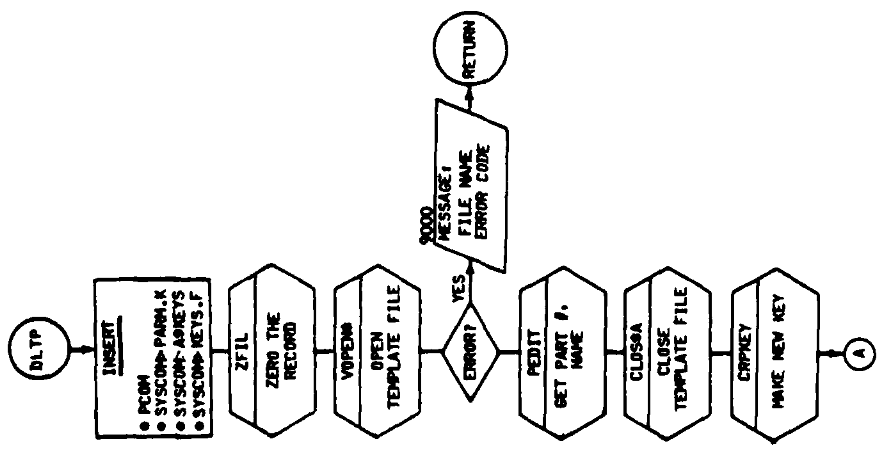


DLTP - DELETE A PLAN

ARGUMENTS: 1

● INTEGER: ERROR

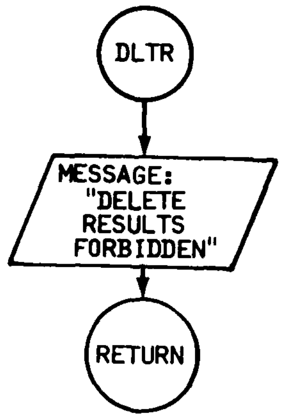




DLTR - DELETE RESULTS

ARGUMENTS: 1

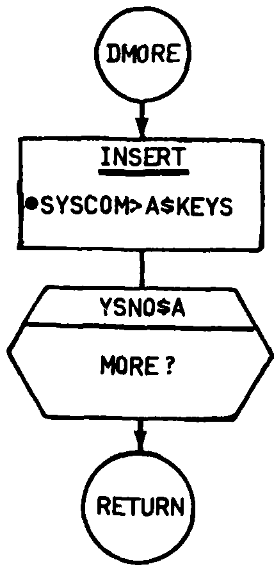
- INTEGER: ERROR



DMORE - DO YOU WANT TO DO MORE?

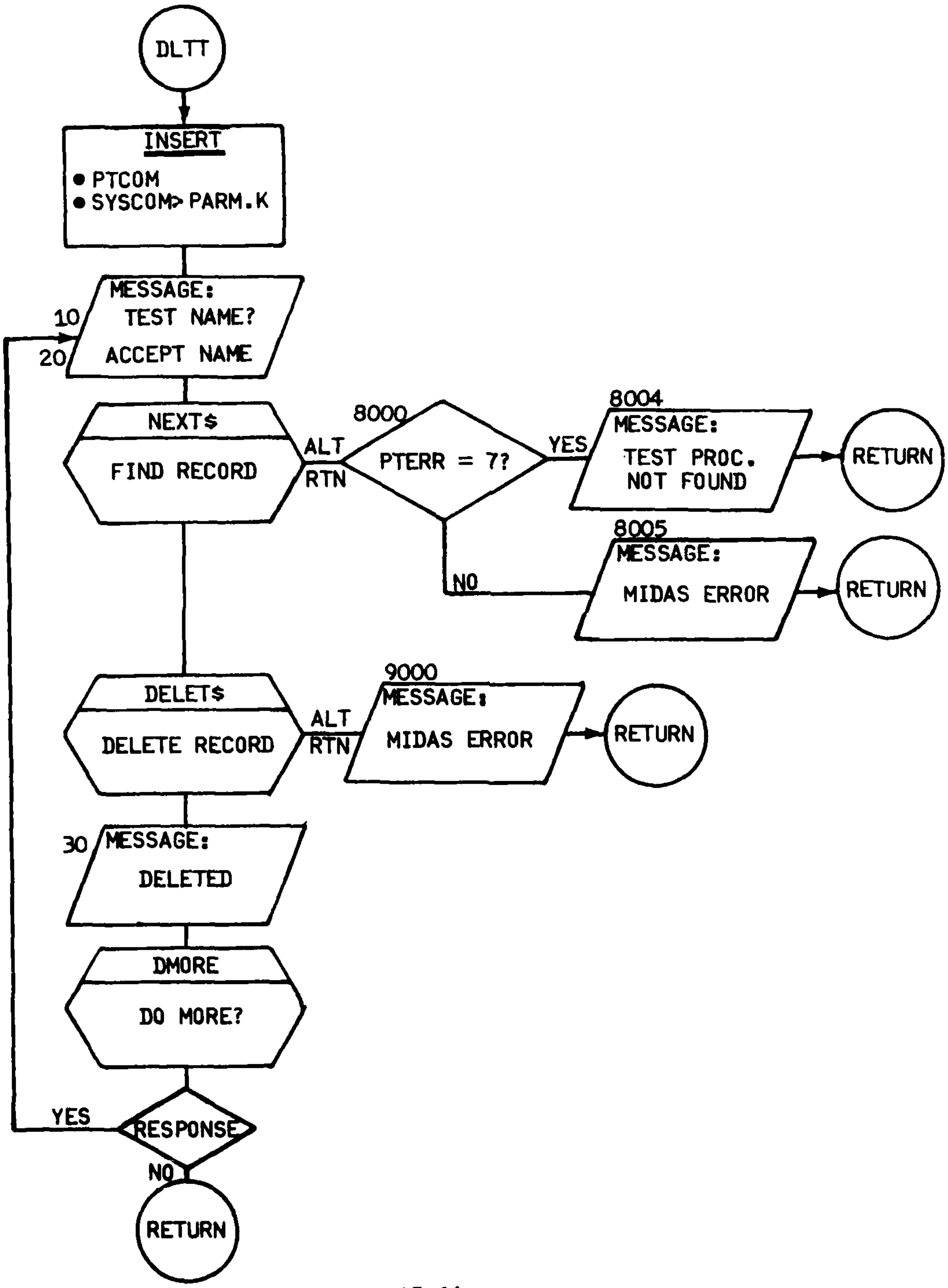
ARGUMENTS: 1

- LOGICAL: MORE



DLTT - DELETE TEST PLAN

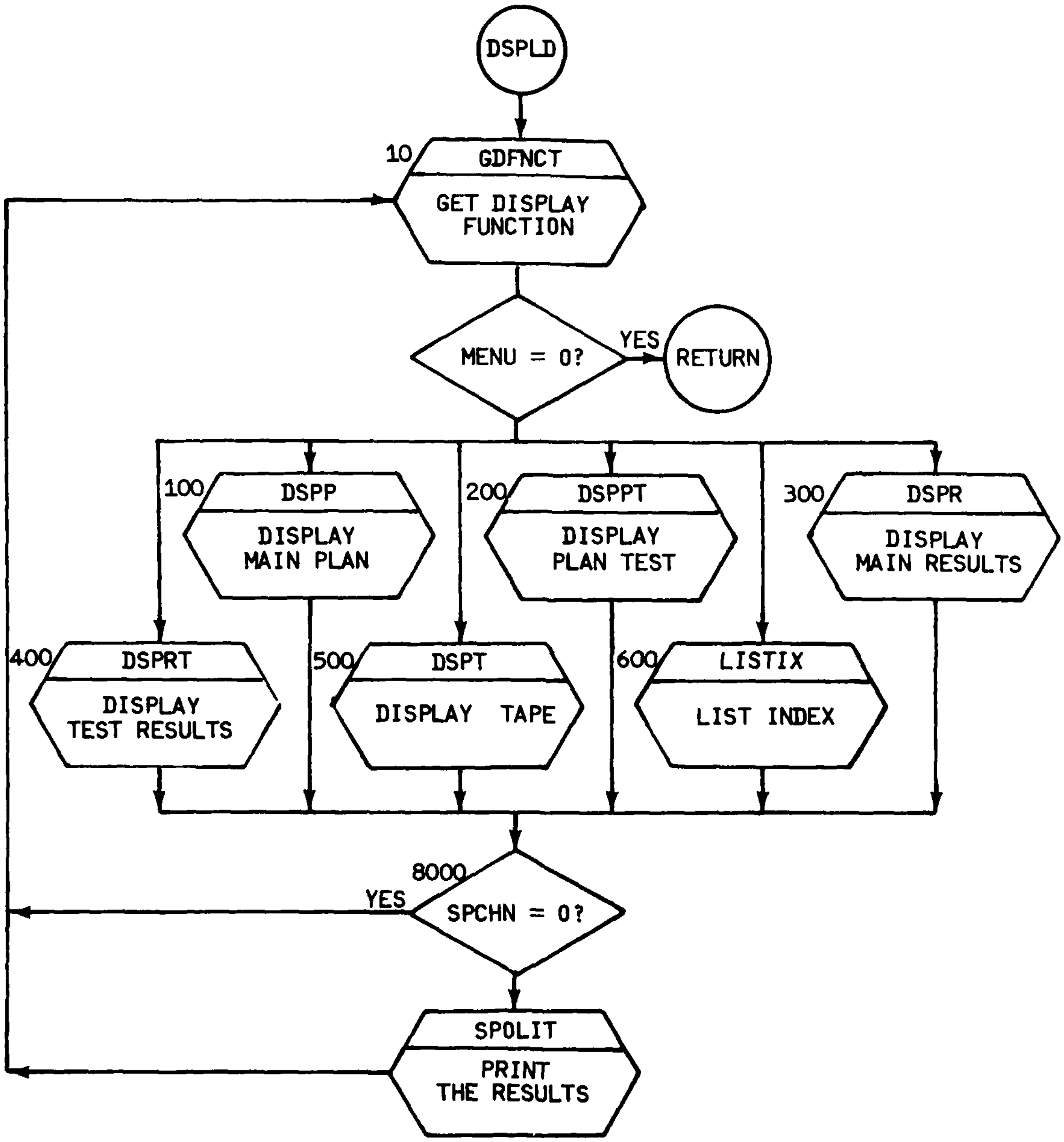
ARGUMENTS: 1
- INTEGER: ERROR



DSPLD - DISPLAY OR PRINT PLAN AND RESULT DATA

ARGUMENTS: 1

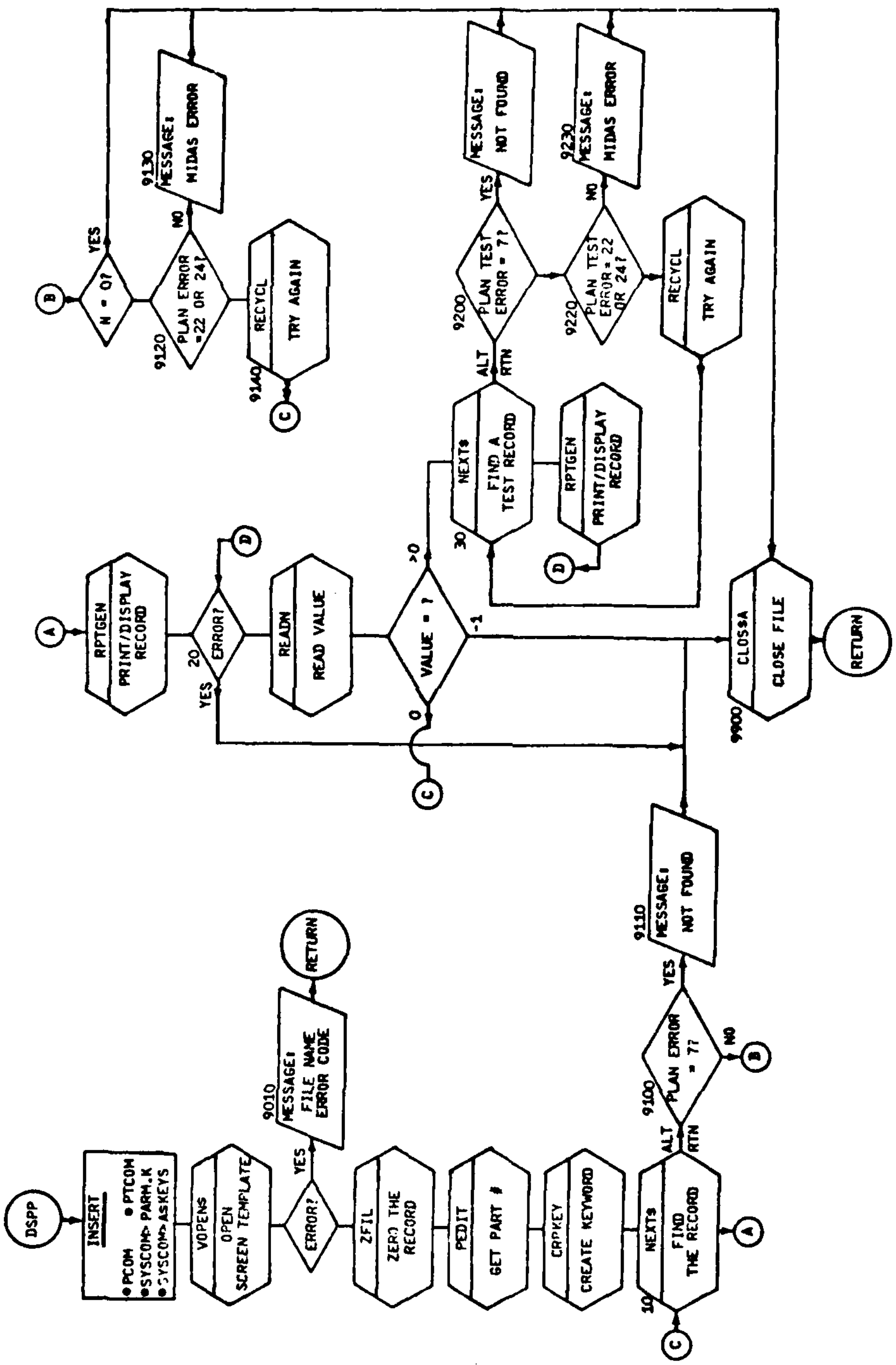
• INTEGER: ERROR



DSPP - DISPLAY MAIN PLAN

ARGUMENTS: 1

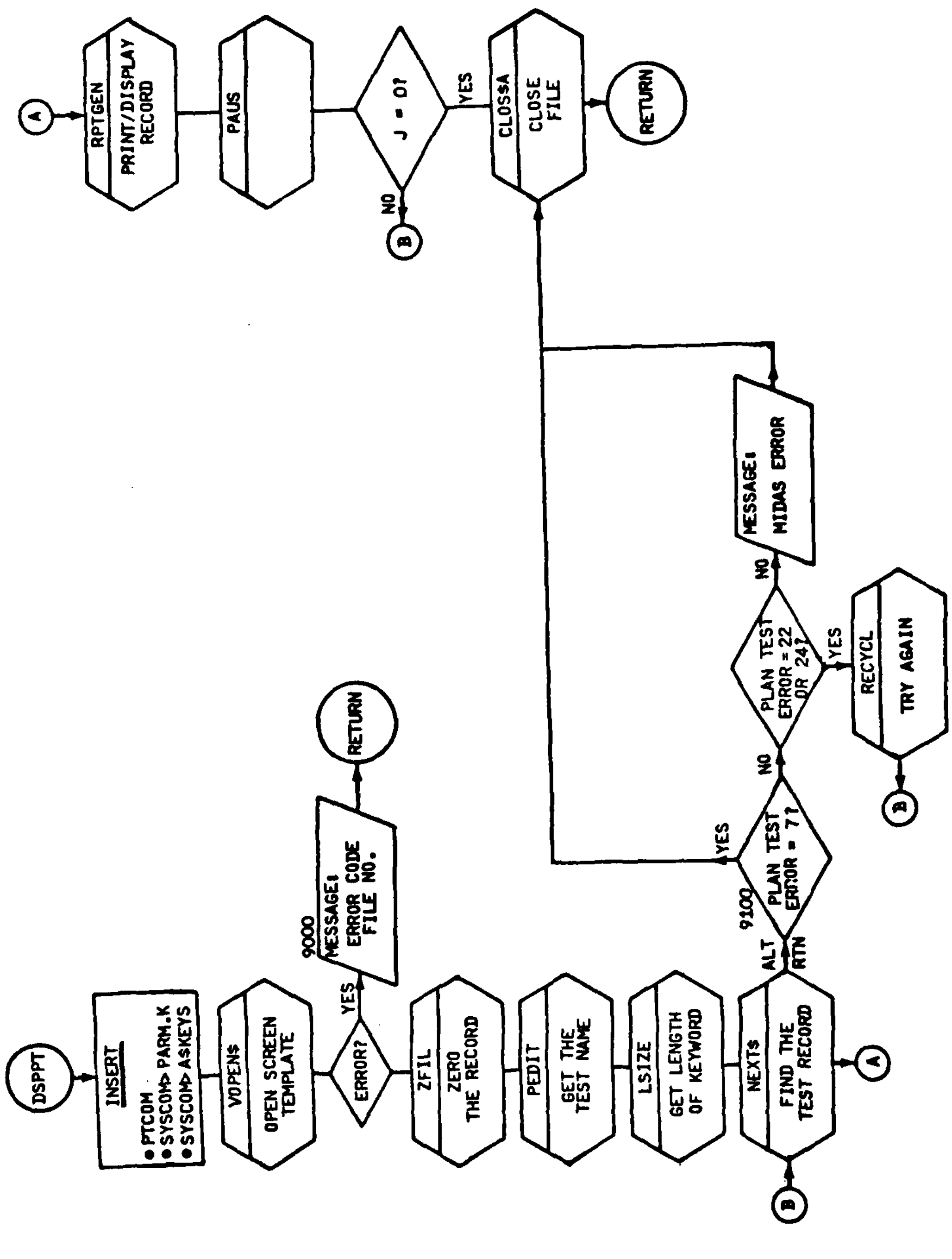
● INTEGER: REPORT CHANNEL



DSPPT - DISPLAY ONE TEST PLAN

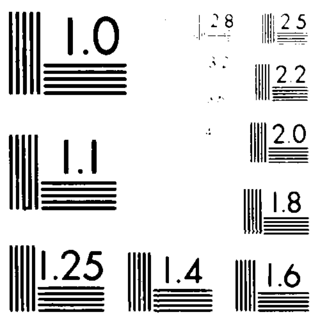
ARGUMENTS: 1

● INTEGER: SPOOL CHANNEL



AD-A098 658 BOEING AEROSPACE CO SEATTLE WA F/G 13/8
LOW COST HIGH VOLUME RADIOGRAPHIC INSPECTION.(U)
JAN 81 N M LOWRY, H J ABPLANALP, J M TANKE DAAK40-78-C-0197
UNCLASSIFIED D180-26159-1 DRSMI/RS-CR-81-1 NL

2 OF 3
AD A
098658

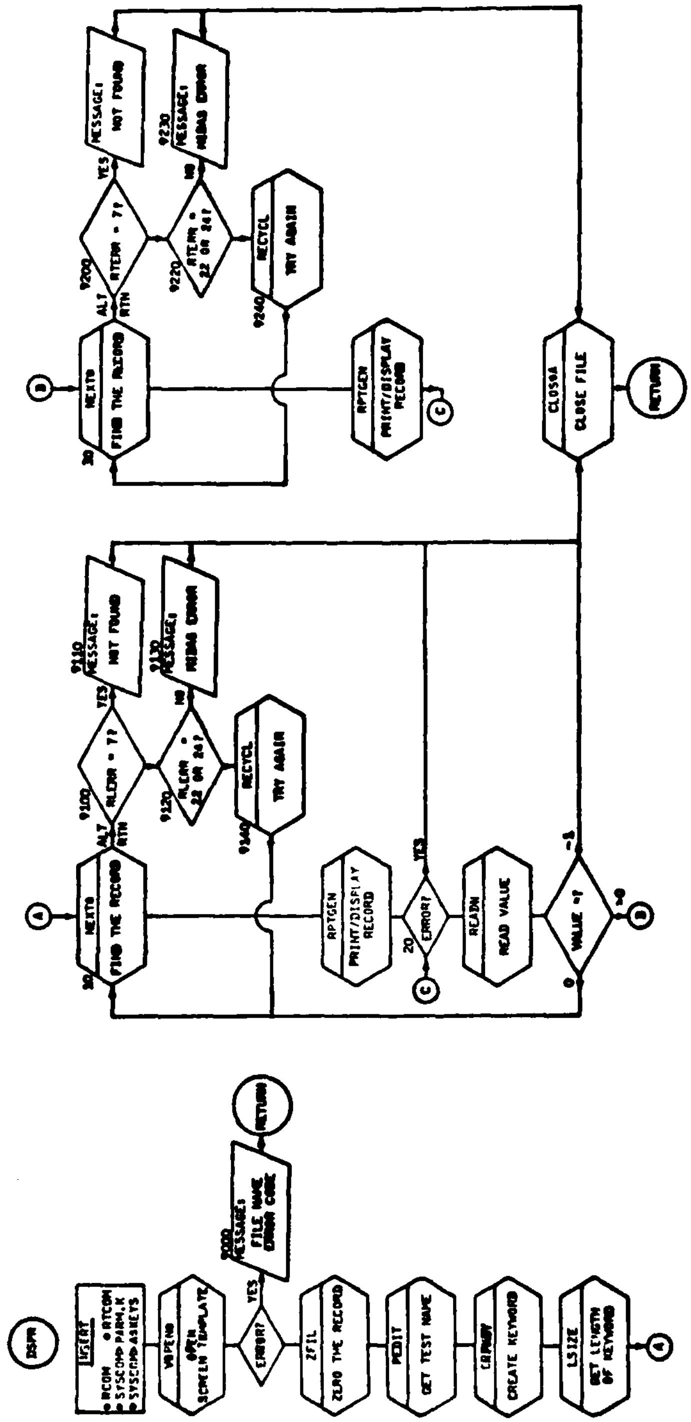


MICROCOPY RESOLUTION TEST CHART

DSPR - DISPLAY RESULTS

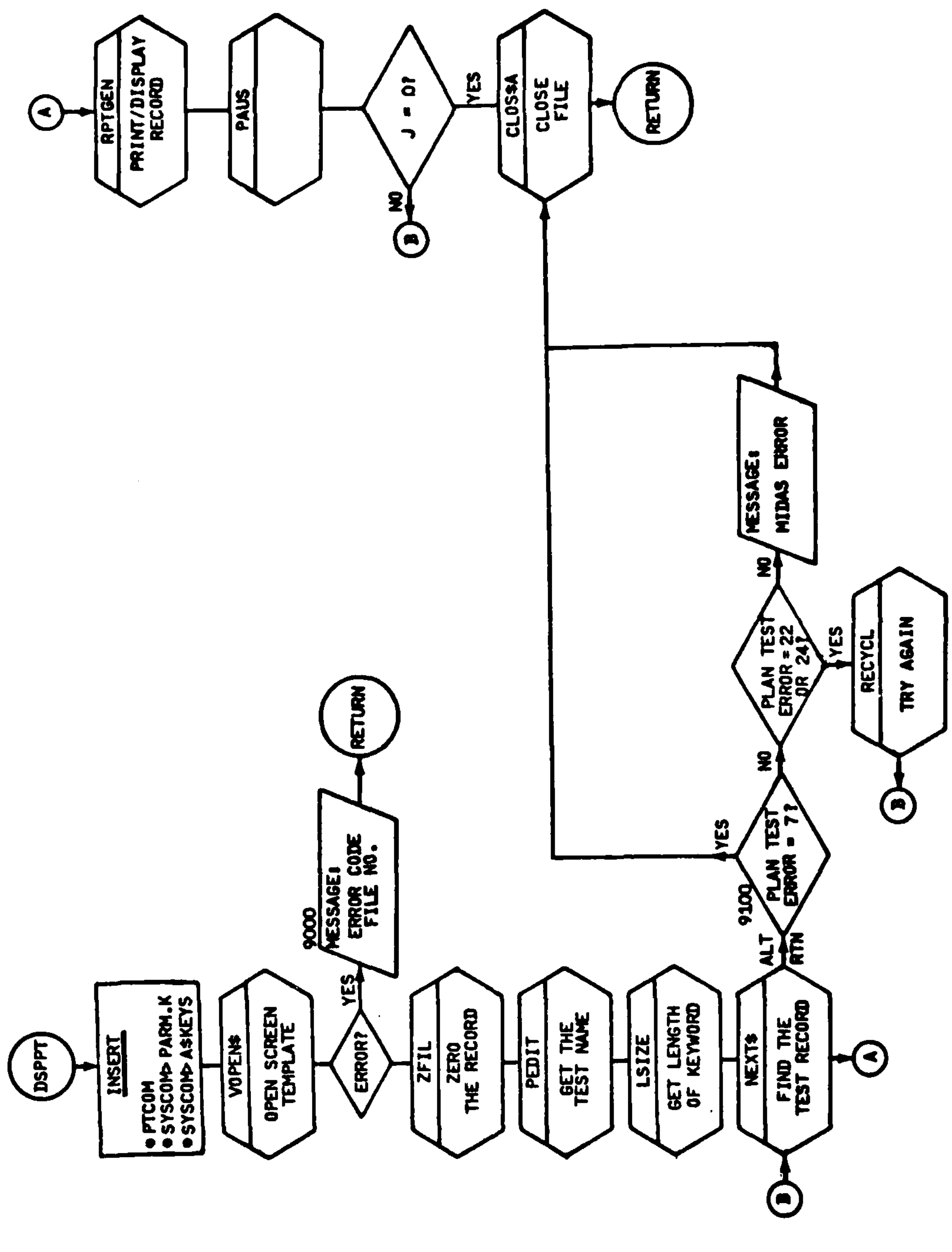
ARGUMENTS: 1

● INTEGER: REPORT CHANNEL



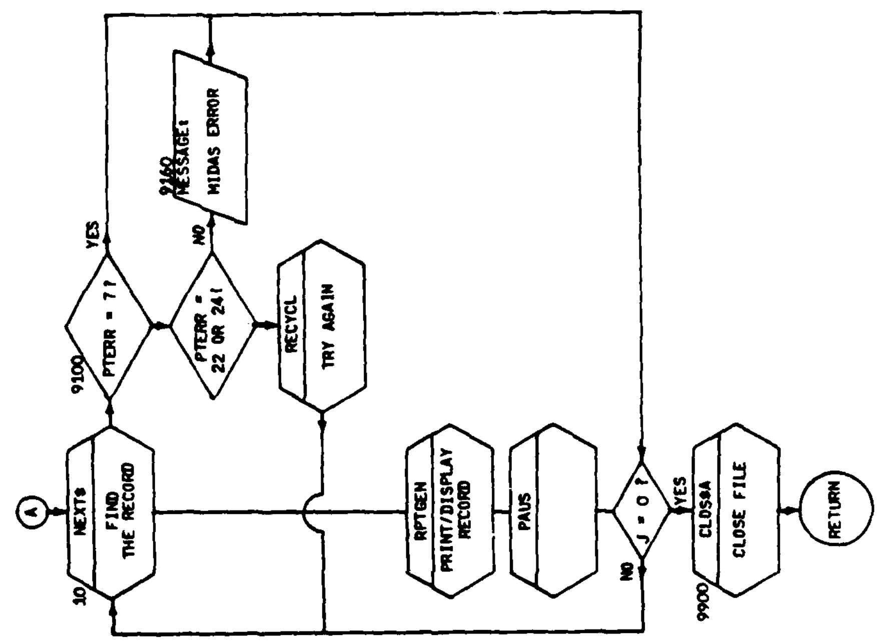
DSPPT - DISPLAY ONE TEST PLAN

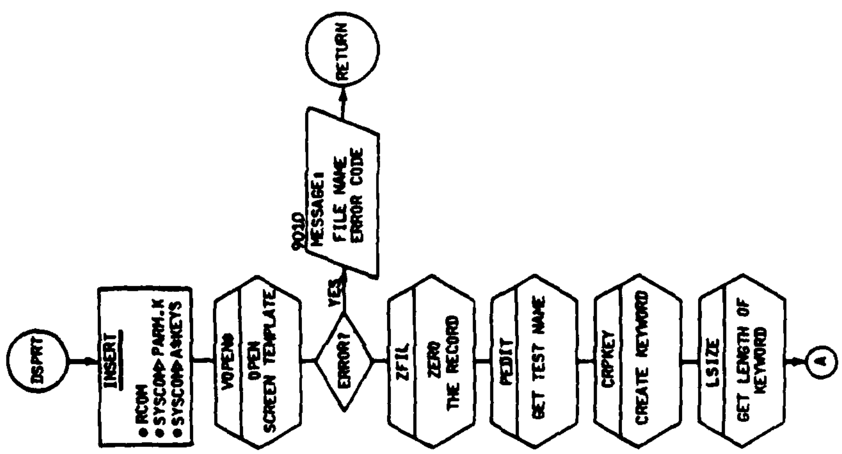
ARGUMENTS: 1
● INTEGER: SPOOL CHANNEL



DSPRT - DISPLAY RESULTS OF ONE TEST

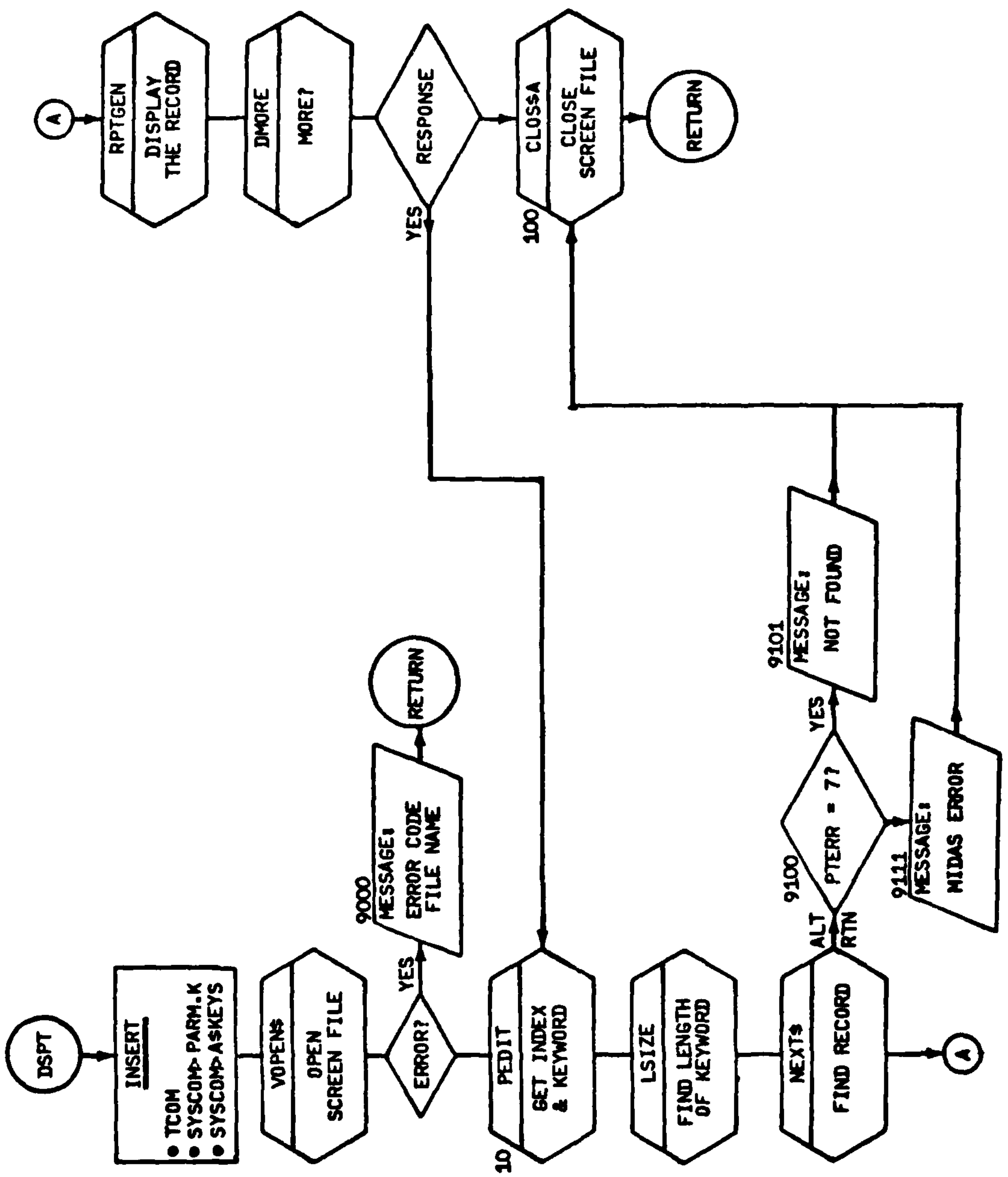
ARGUMENTS: 1
- **INTEGER: SPOOL CHANNEL**





DSPT - DISPLAY TAPE DATA

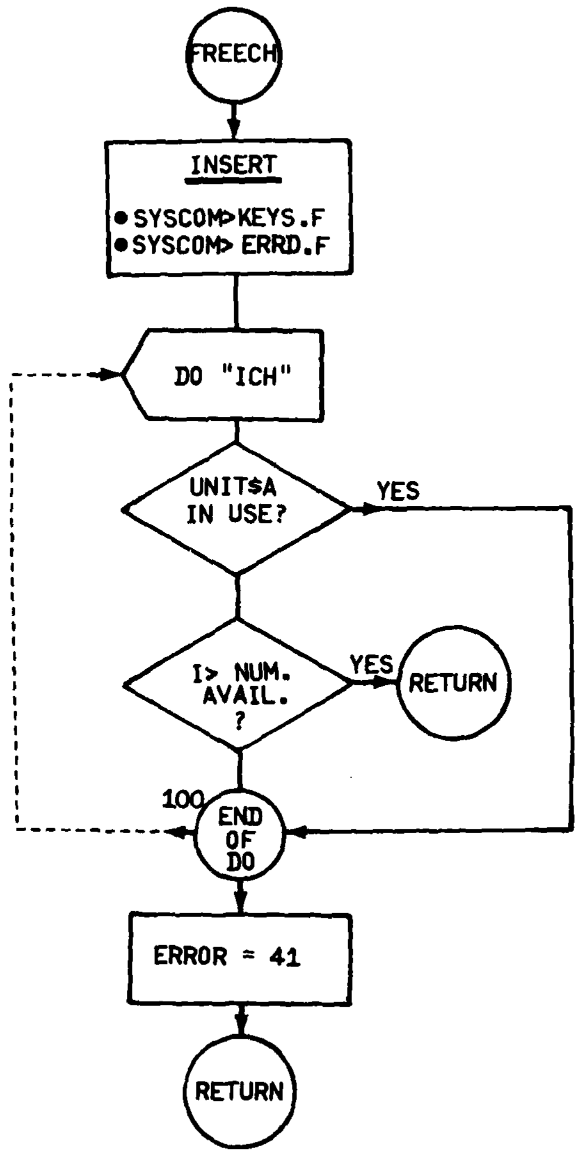
ARGUMENTS: 1
● INTEGER: SPOOL FILE CHANNEL



FREECH - RETURN THE NUMBER OF AVAILABLE PRIMOS CHANNELS

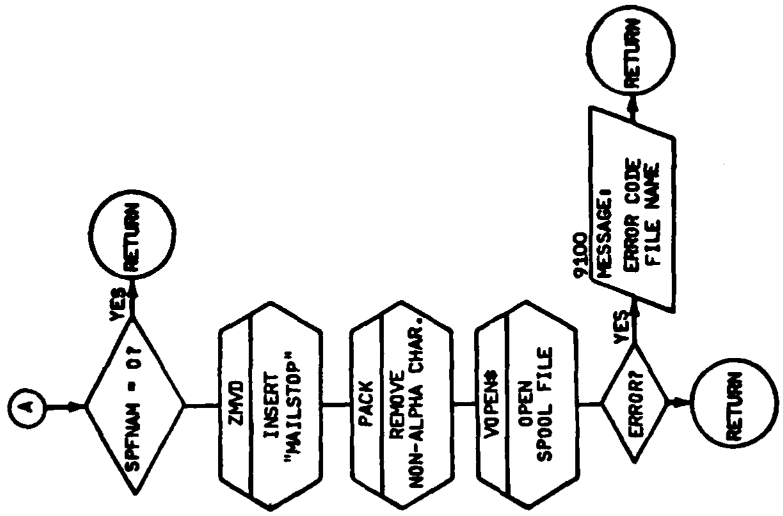
ARGUMENTS: 2

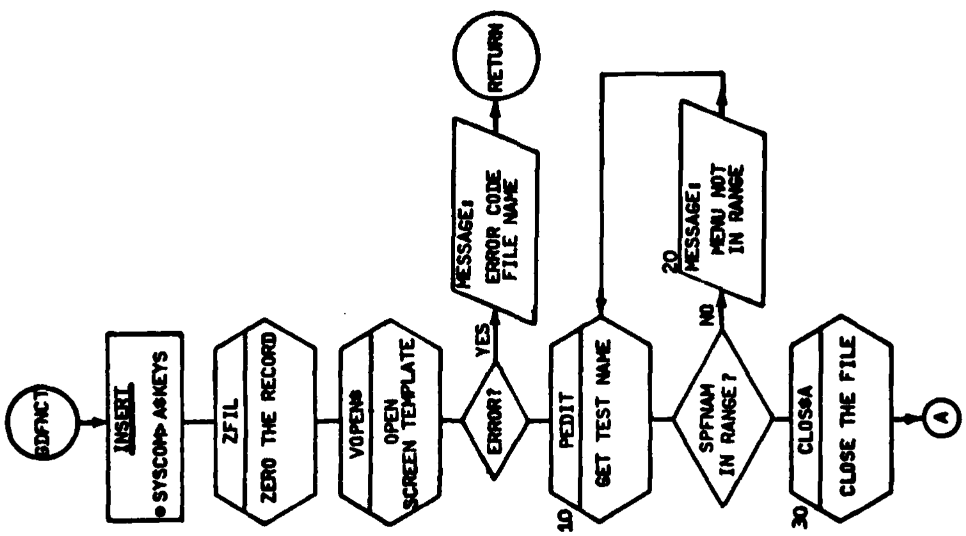
- INTEGER: FREE CHANNELS REQUESTED
- INTEGER: ARRAY SIZE



GDFNCT - GET DISPLAY FUNCTION

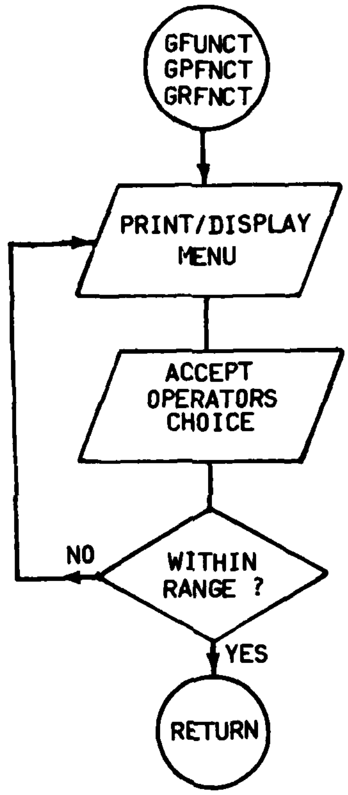
ARGUMENTS: 3
- INTEGER: MENU
- INTEGER: SPOOL CHANNEL NUMBER
- INTEGER: SPOOL FILE NAME





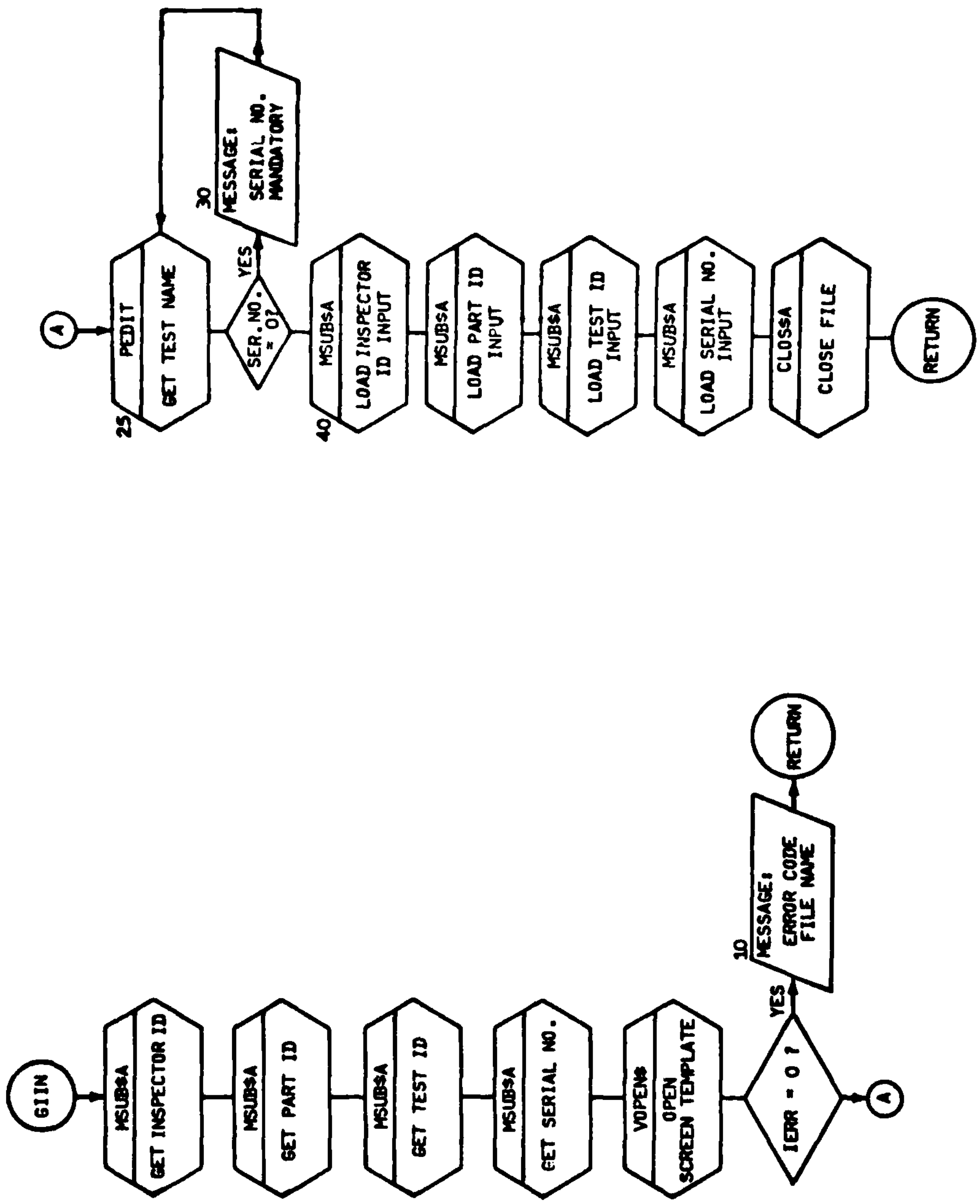
GFUNCT - GET FUNCTION, MAIN MENU
GPFNCT - GET PLAN FUNCTION
GRFNCT - GET RETRIEVAL FUNCTION

ARGUMENTS: 1
- INTEGER: MENU



GIIN - GET INSPECTOR INPUT

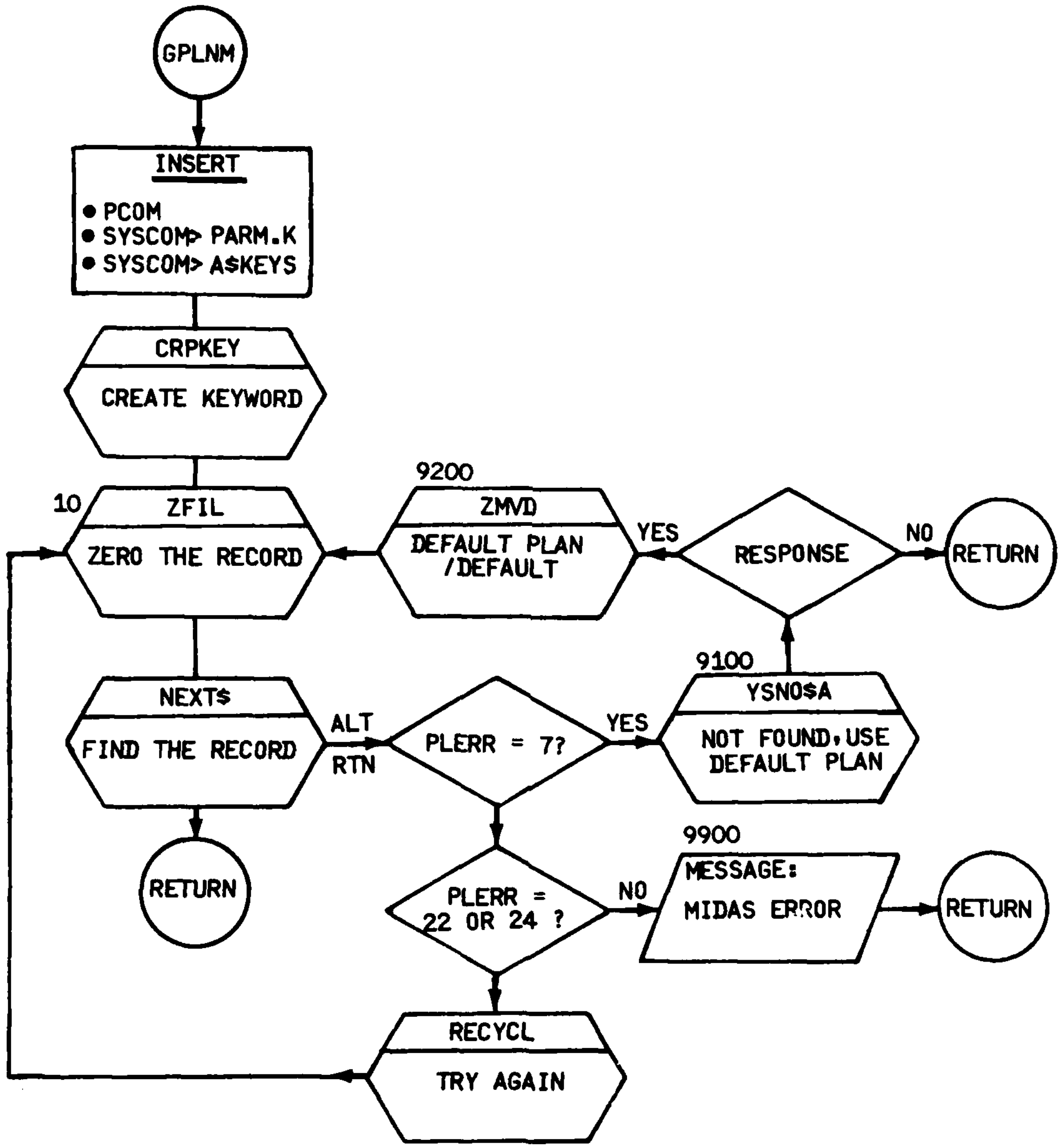
ARGUMENTS: 5
- STRING: INSPECTOR I.D.
- STRING: SERIAL NUMBER
- LOGICAL: EQUIP. INIT. FLAG
- LOGICAL: DEFAULT PLAN FLAG
- INTEGER: ERROR CODE



GPLNM - GET PLAN RECORD

ARGUMENTS: 4

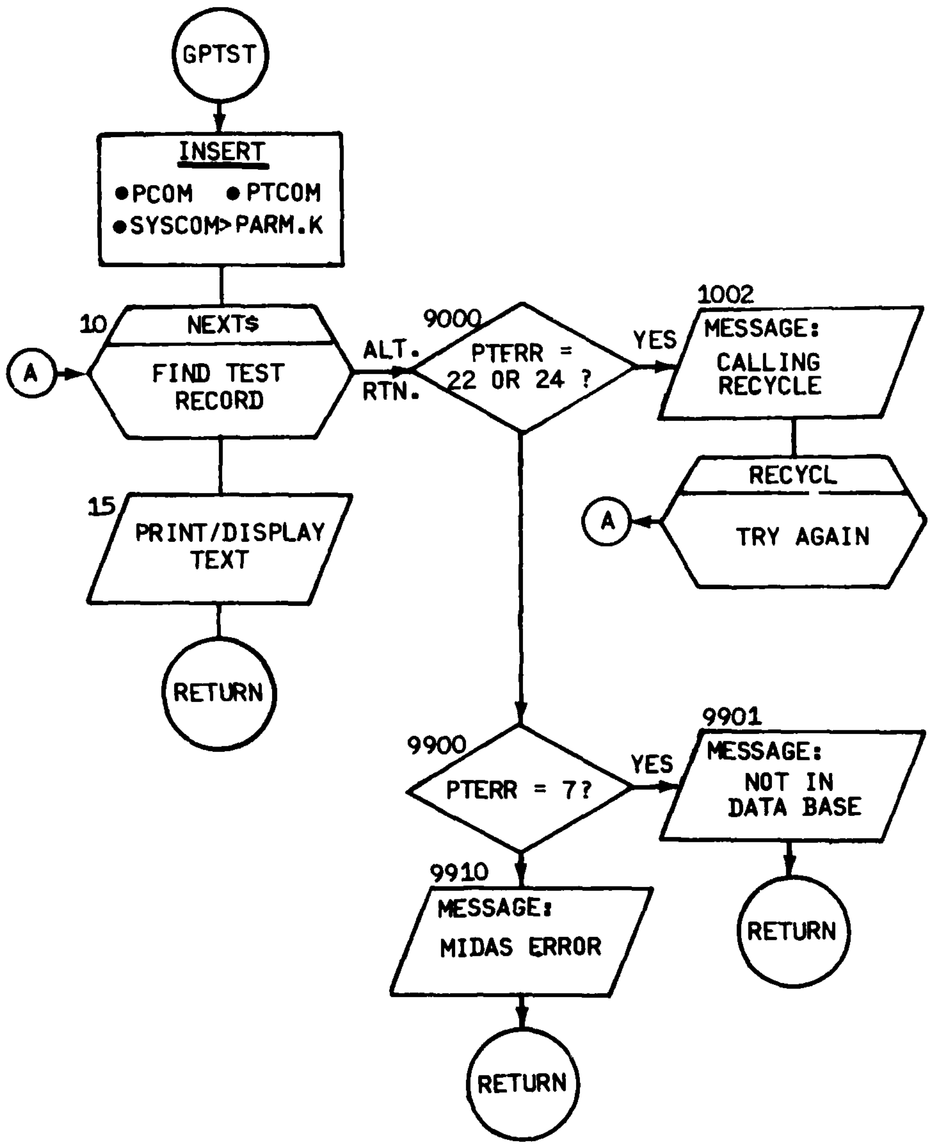
- INTEGER: PART NO.
- INTEGER: TEST ID
- LOGICAL: DEFAULT PLAN
- INTEGER: ERROR



GPTST - GET A TEST PLAN

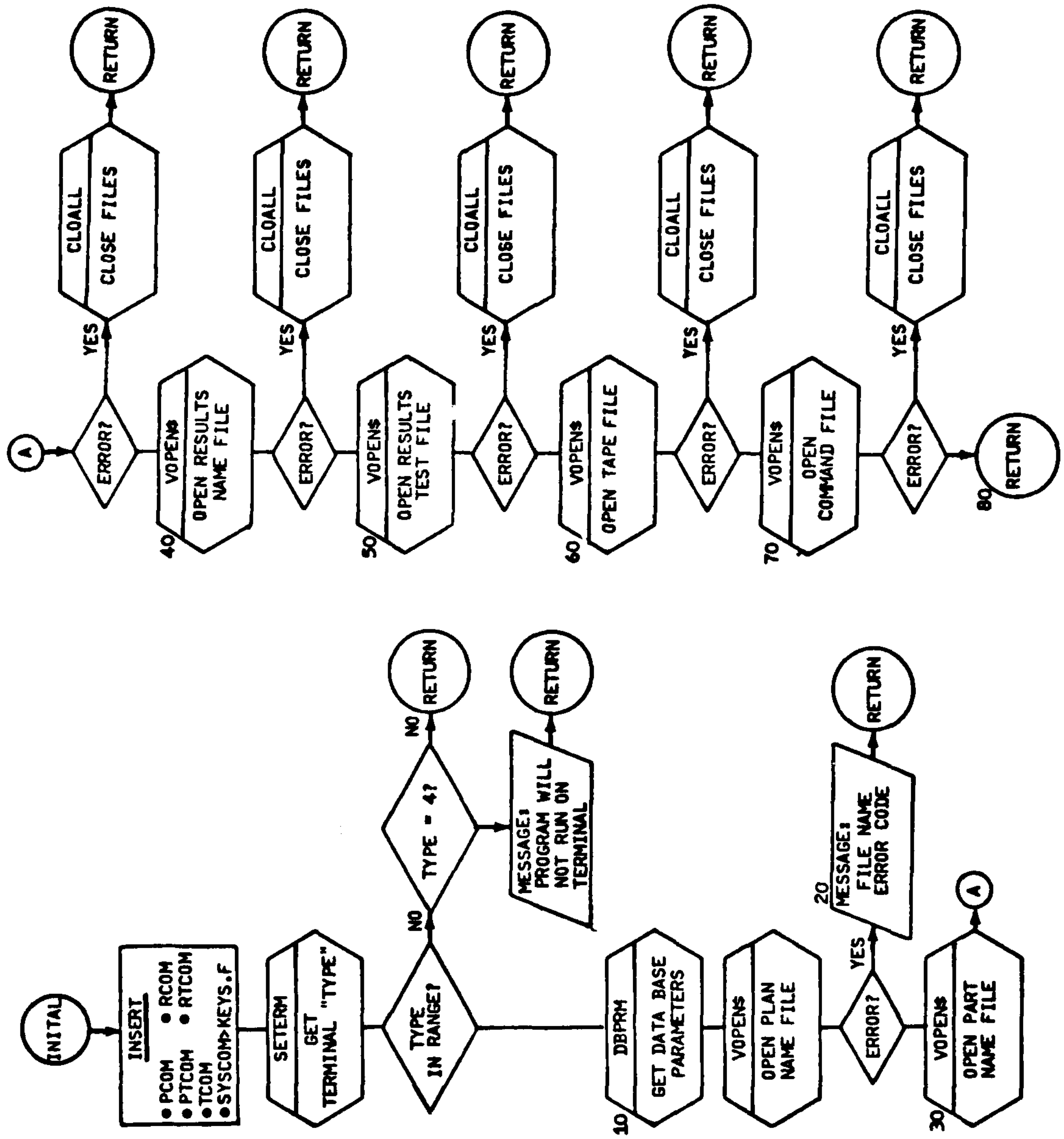
ARGUMENTS: 2

- INTEGER: TEST NO.
- INTEGER: ERROR



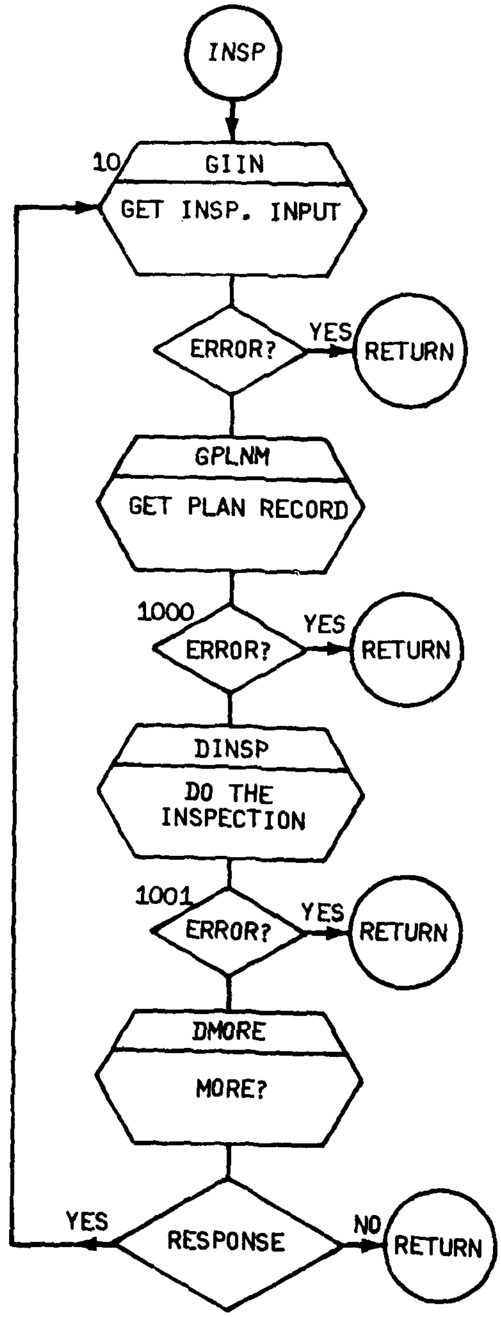
INITAL - SET UP TERMINAL CODES AND OPEN DATA BASE FILES

ARGUMENTS: 1
● INTEGER: ERROR



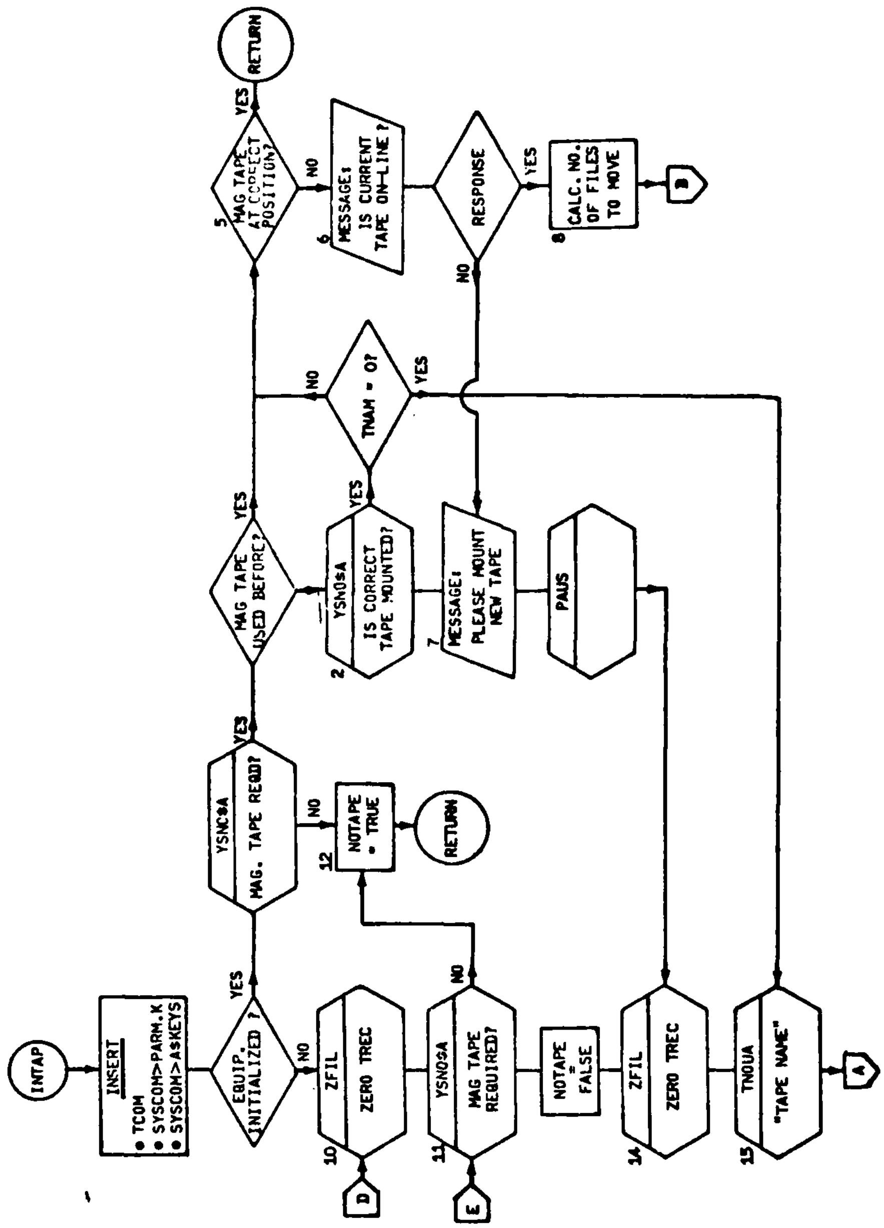
INSP - PERFORM AN INSPECTION

ARGUMENTS: 2
LOGICAL: EQUIPMENT
INTEGER: ERROR



INTAP - INITIALIZE TAPE

ARGUMENTS: 3
- INTEGER: EQUIPMENT INIT. FLAG
- INTEGER: EQUIP. IN USE FLAG
- INTEGER: ERROR



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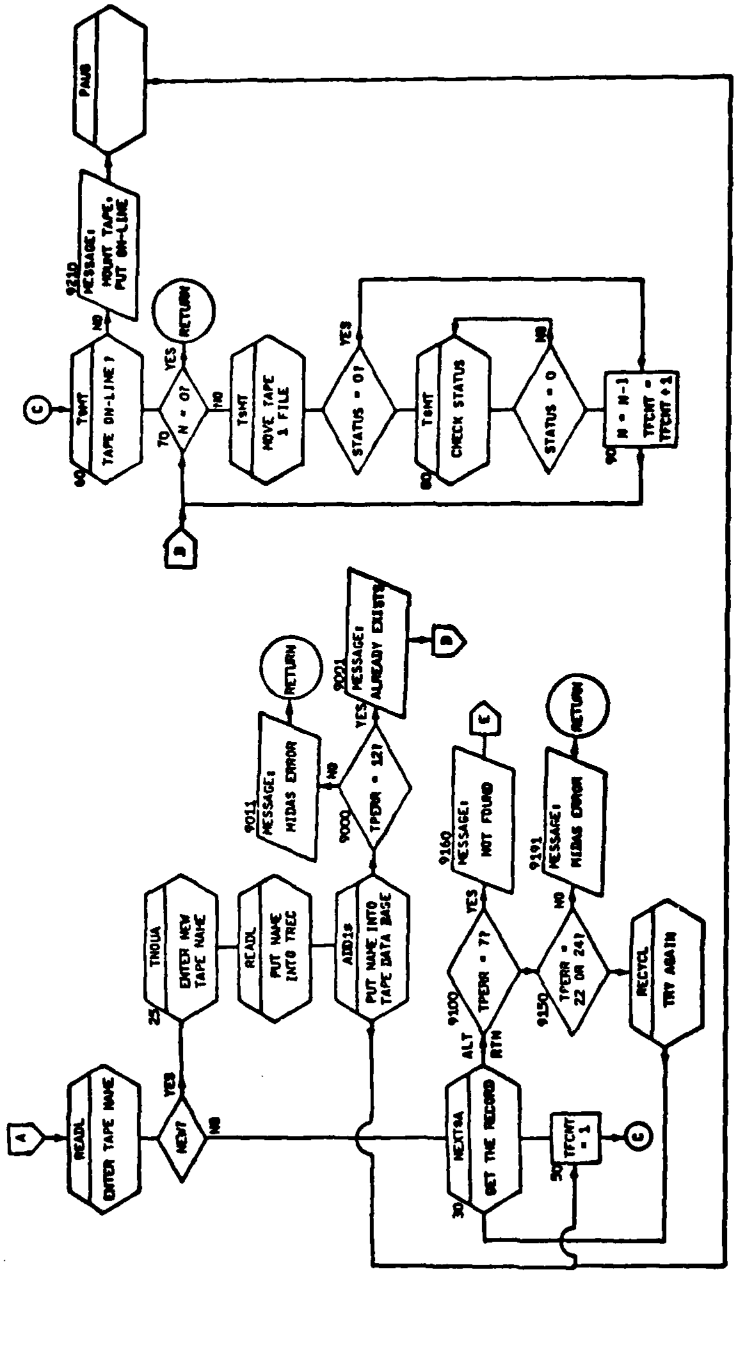
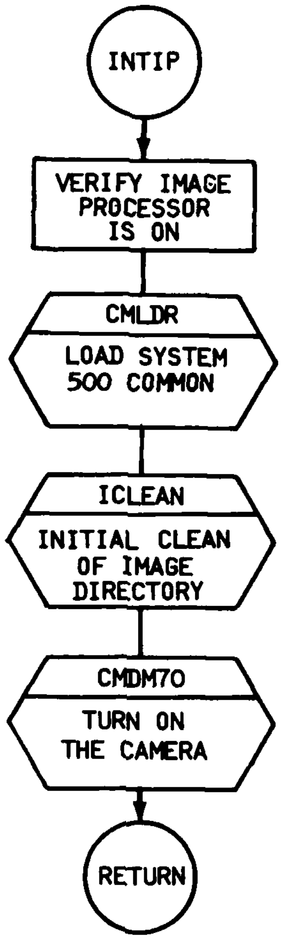
INTAP - INITIALIZE TAPE (CONT'D)



INTIP - INITIALIZE THE IMAGE PROCESSOR

ARGUMENTS: 1

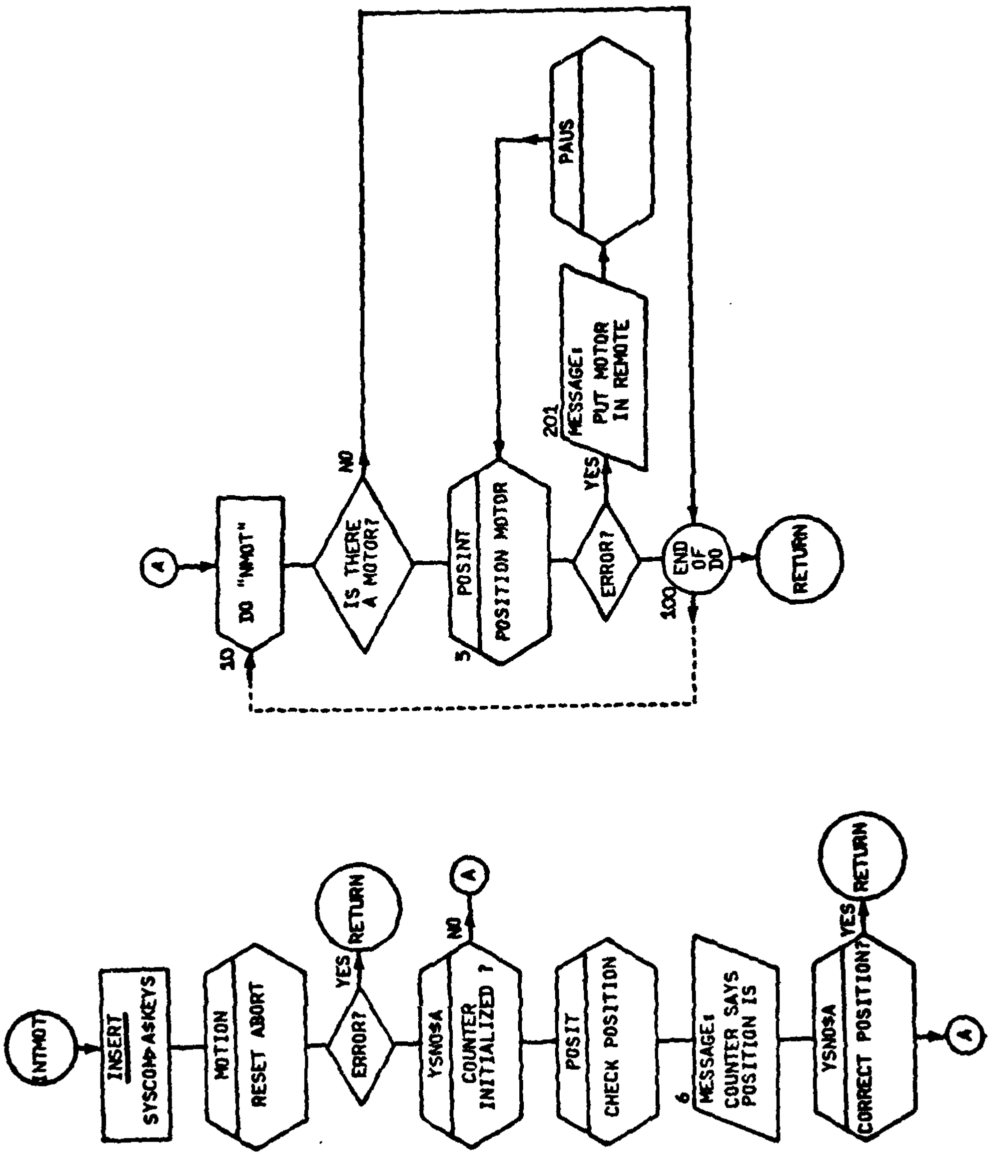
- INTEGER: ERROR



INTMOT - INITIALIZE MOTORS

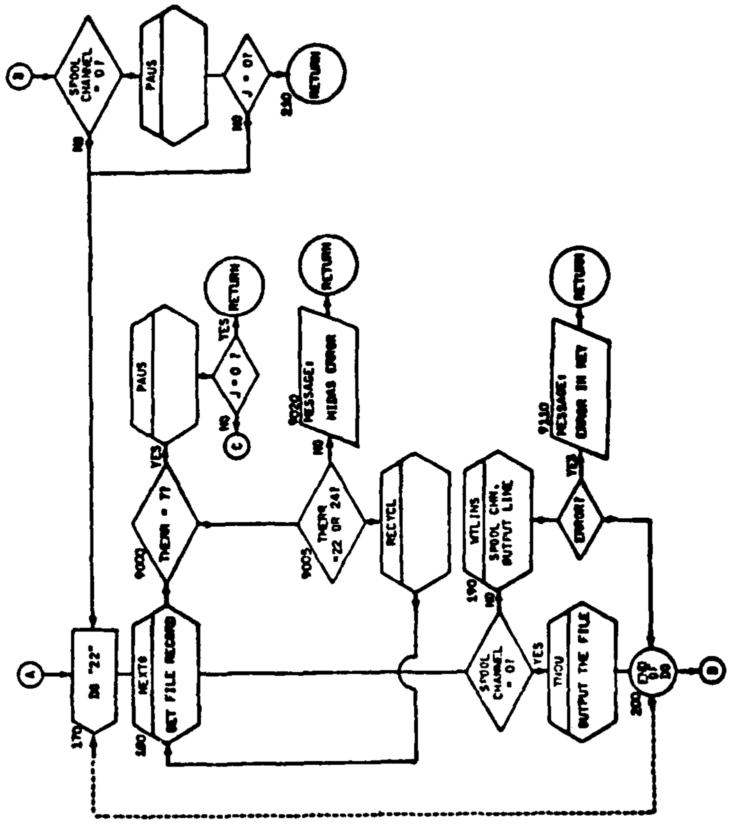
ARGUMENTS: 1

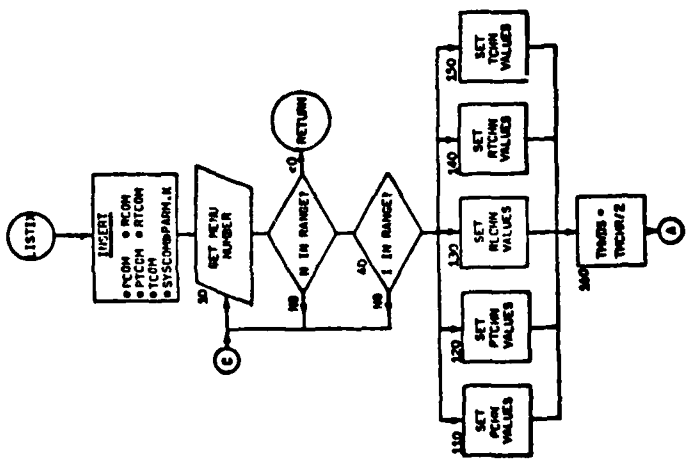
● INTEGER: ERROR



LISTIX - LIST KEY NAMES BY INDEX

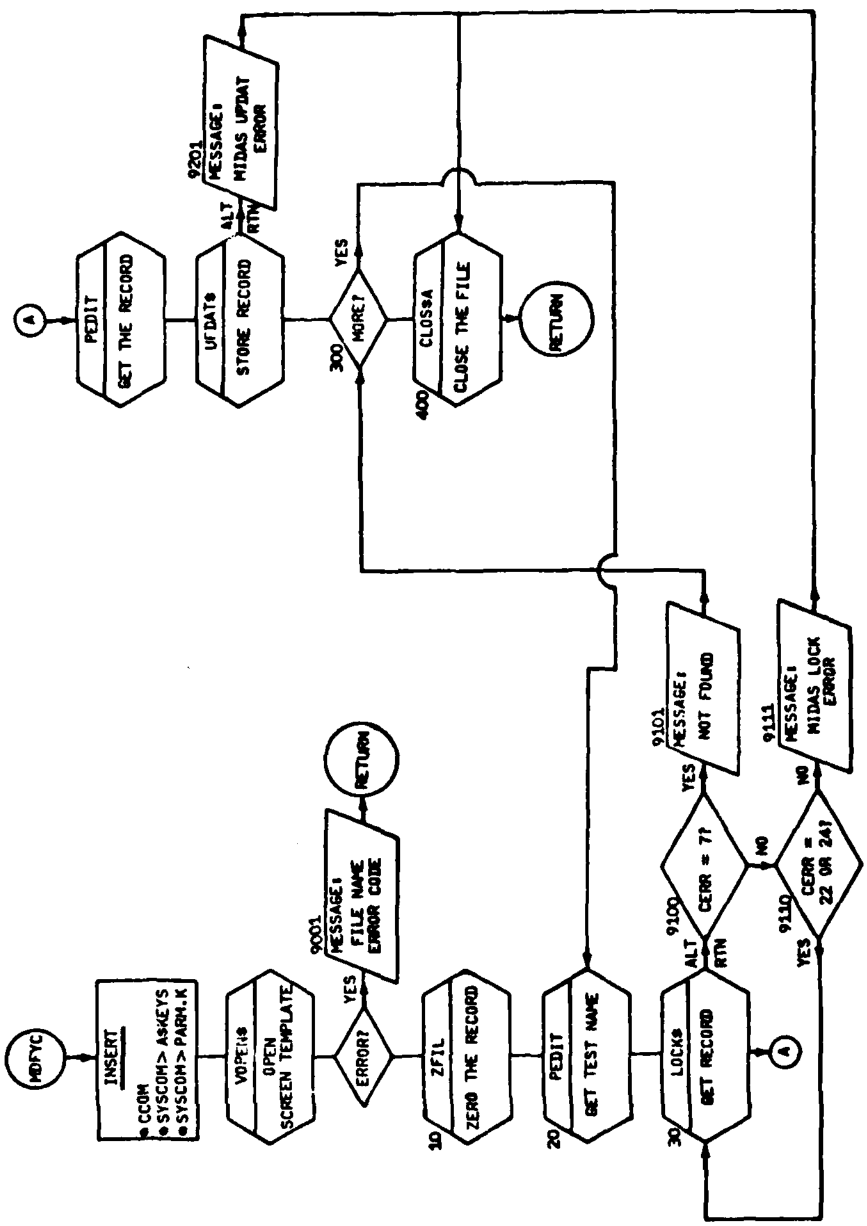
ARGUMENTS: 1
● INTEGER: SPOOL CHANNEL NUMBER





MDFYC - MODIFY IMAGE PROCESSOR COMMAND

ARGUMENTS: 1
● INTEGER: ERROR



MDFYP - MODIFY PLAN
MKFMC - MAKE IMAGE COMMAND FROM OLD
MKFMP - MAKE FROM PLAN
MKFMT - MAKE FROM TEST

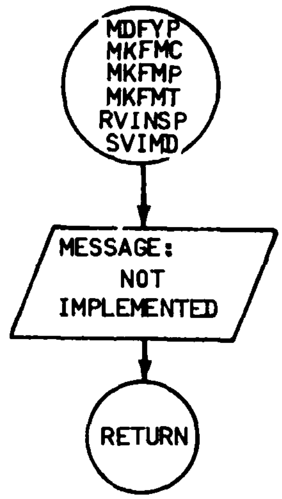
ARGUMENTS: 1
- INTEGER: ERROR

RVINSP - RECREATE AN INSPECTION

ARGUMENTS: NONE

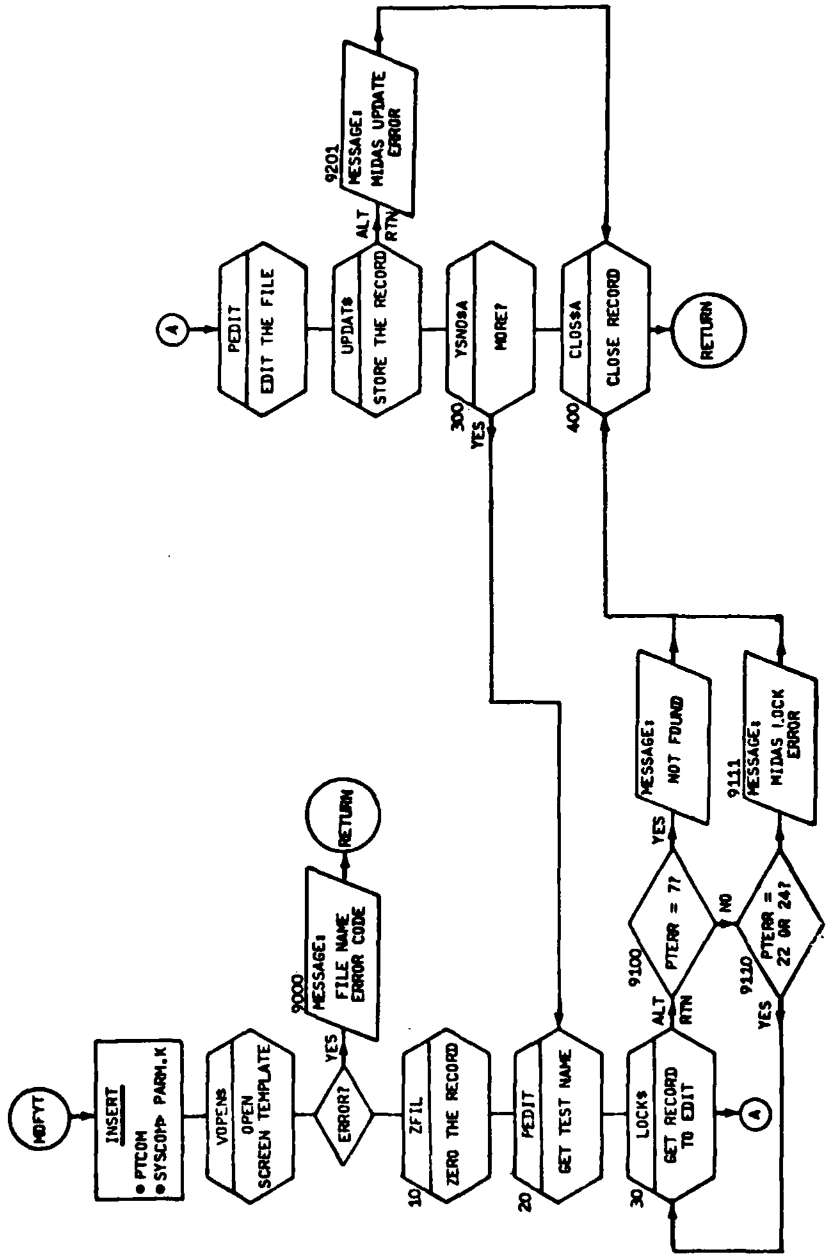
SVIMD - SAVE IMAGE ON DISK

ARGUMENTS: 1
- STRING: NAME



MDFYT - MODIFY TEST PROCEDURE

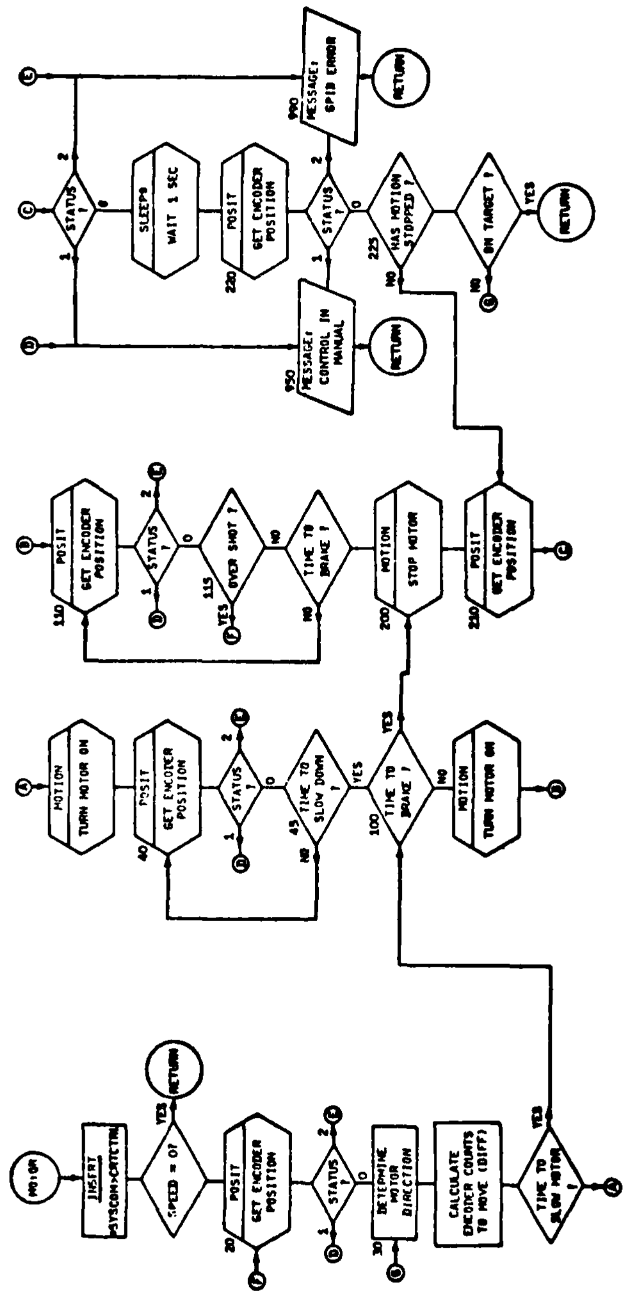
ARGUMENTS: 1
● INTEGER: ERROR



MOTOR - CONTROL MOTION OF A MOTOR

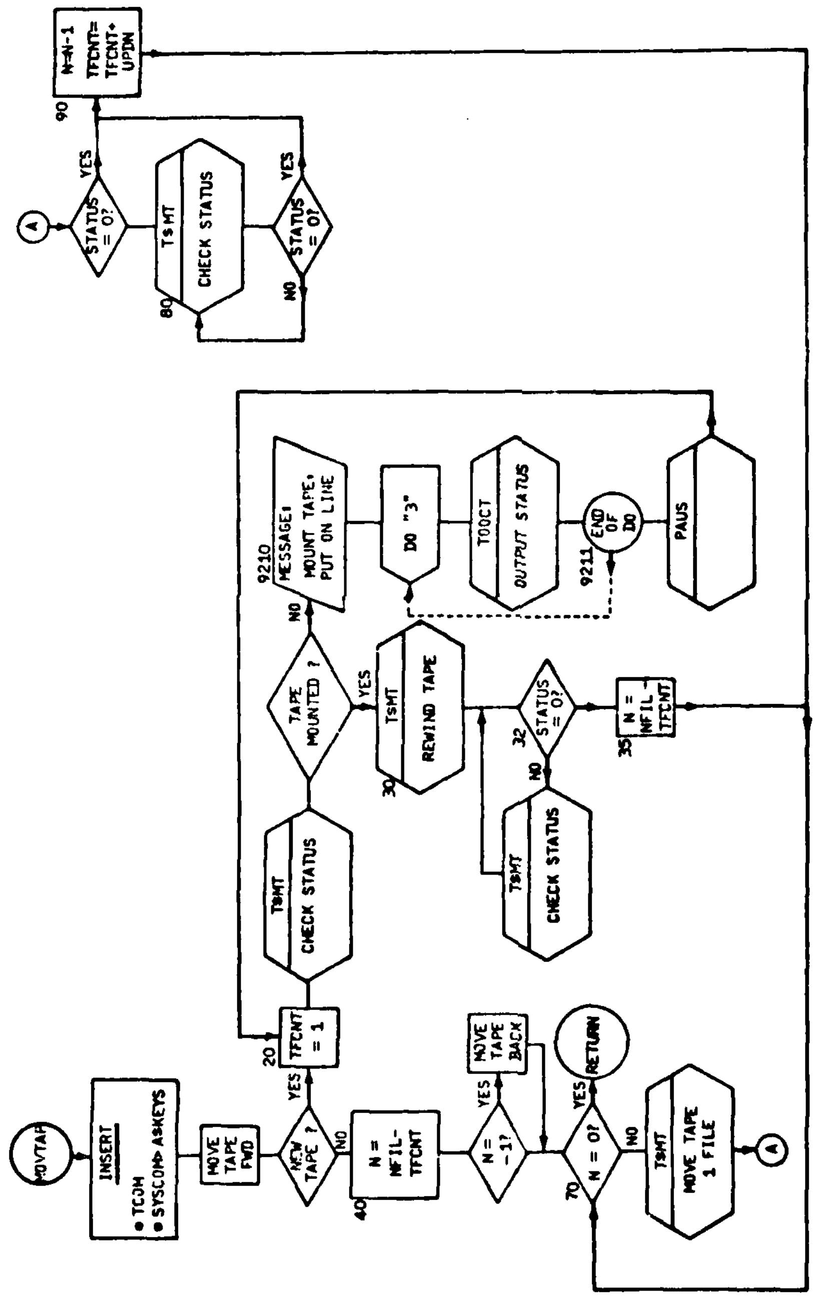
ARGUMENTS: 4

- INTEGER: MOTOR NUMBER
- INTEGER: MOTOR SPEED
- INTEGER: POSITION
- INTEGER: ERROR



MOVTAP - VERIFY AND MOVE TAPE

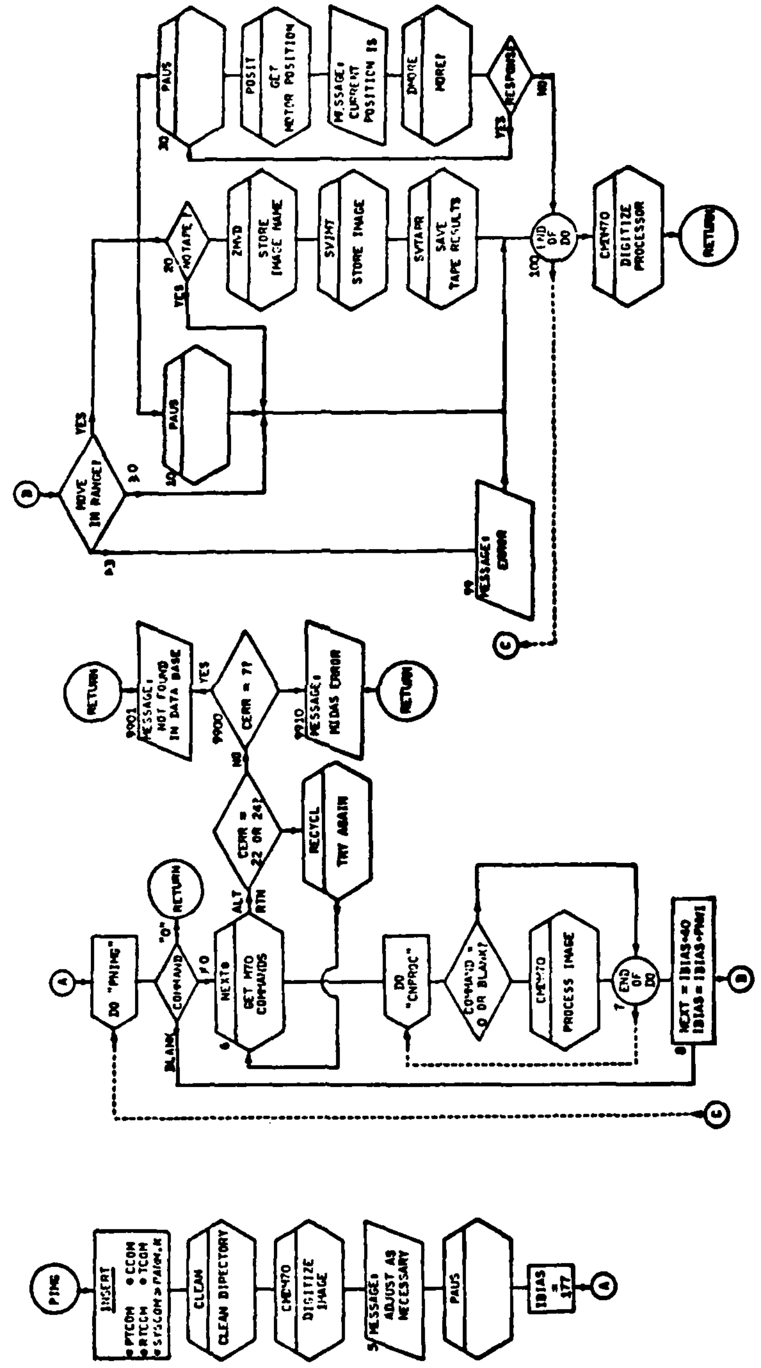
ARGUMENTS: 3
- LOGICAL: NEW TAPE
- INTEGER: FILE NO. TO POSITION TAPE
- INTEGER: ERROR



PIMG - PROCESS THE IMAGE

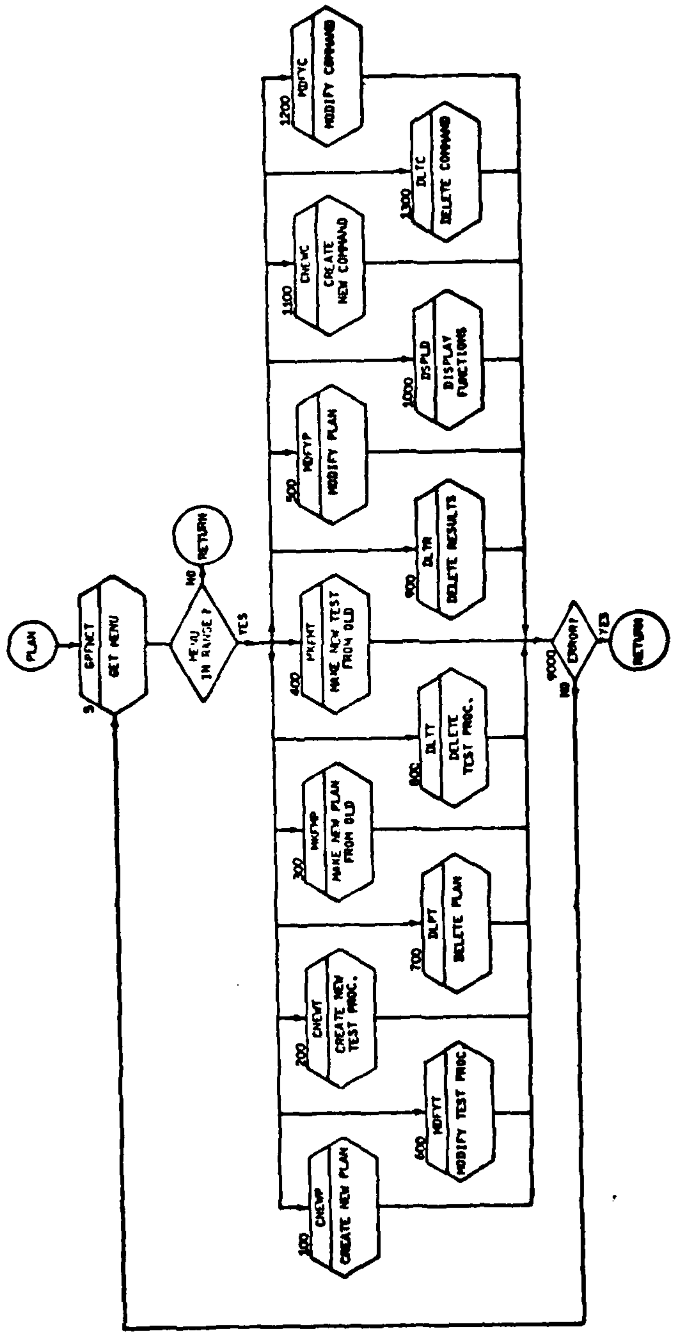
ARGUMENTS: 3

- INTEGER: TEST SEQUENCE NO.
- LOGICAL: NO TAPE FLAG
- INTEGER: ERROR



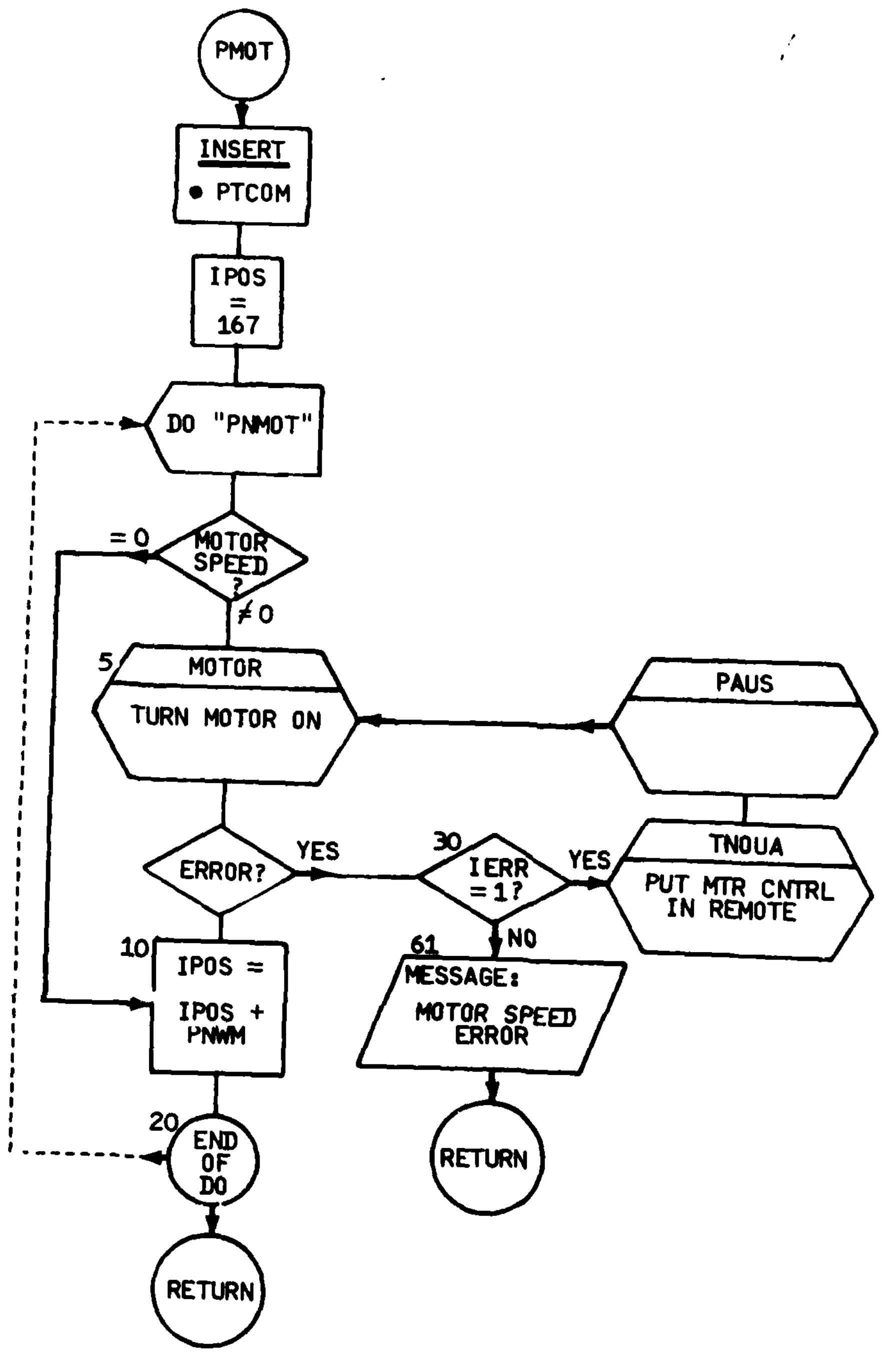
PLAN - MAIN PLANNING ROUTINE

ARGUMENTS: 1
● INTEGER: ERROR



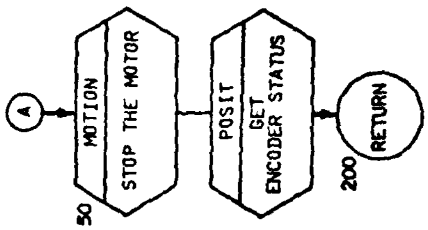
PMOT - POSITION MOTORS

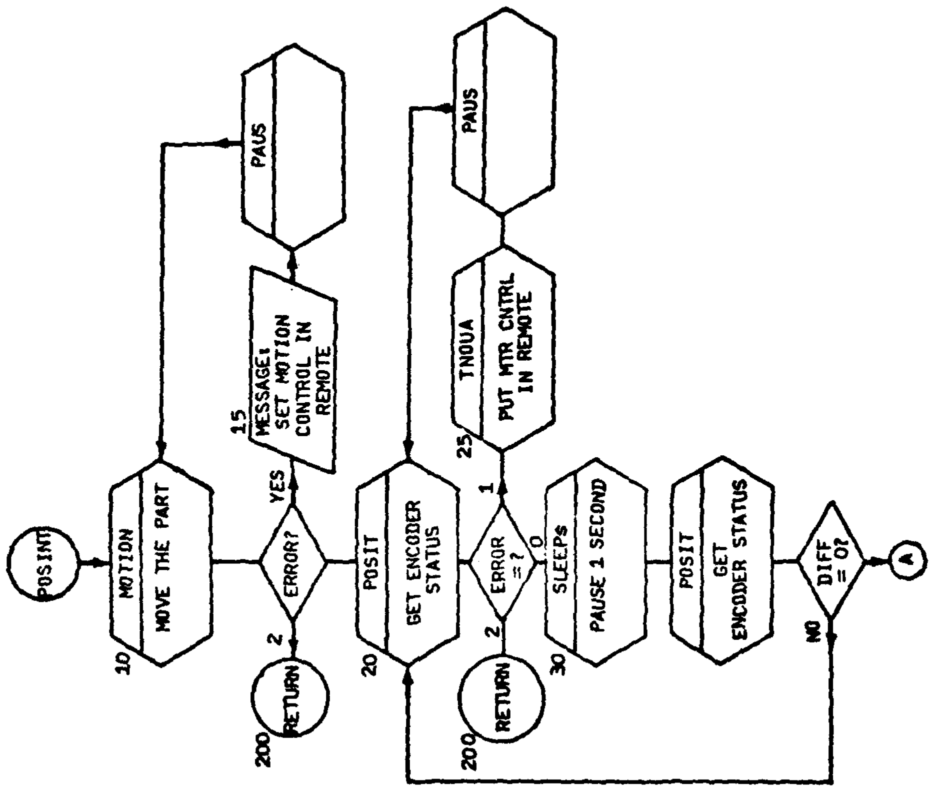
ARGUMENTS: NONE



POSINT - POSITION MOTOR & INITIALIZE ENCODER

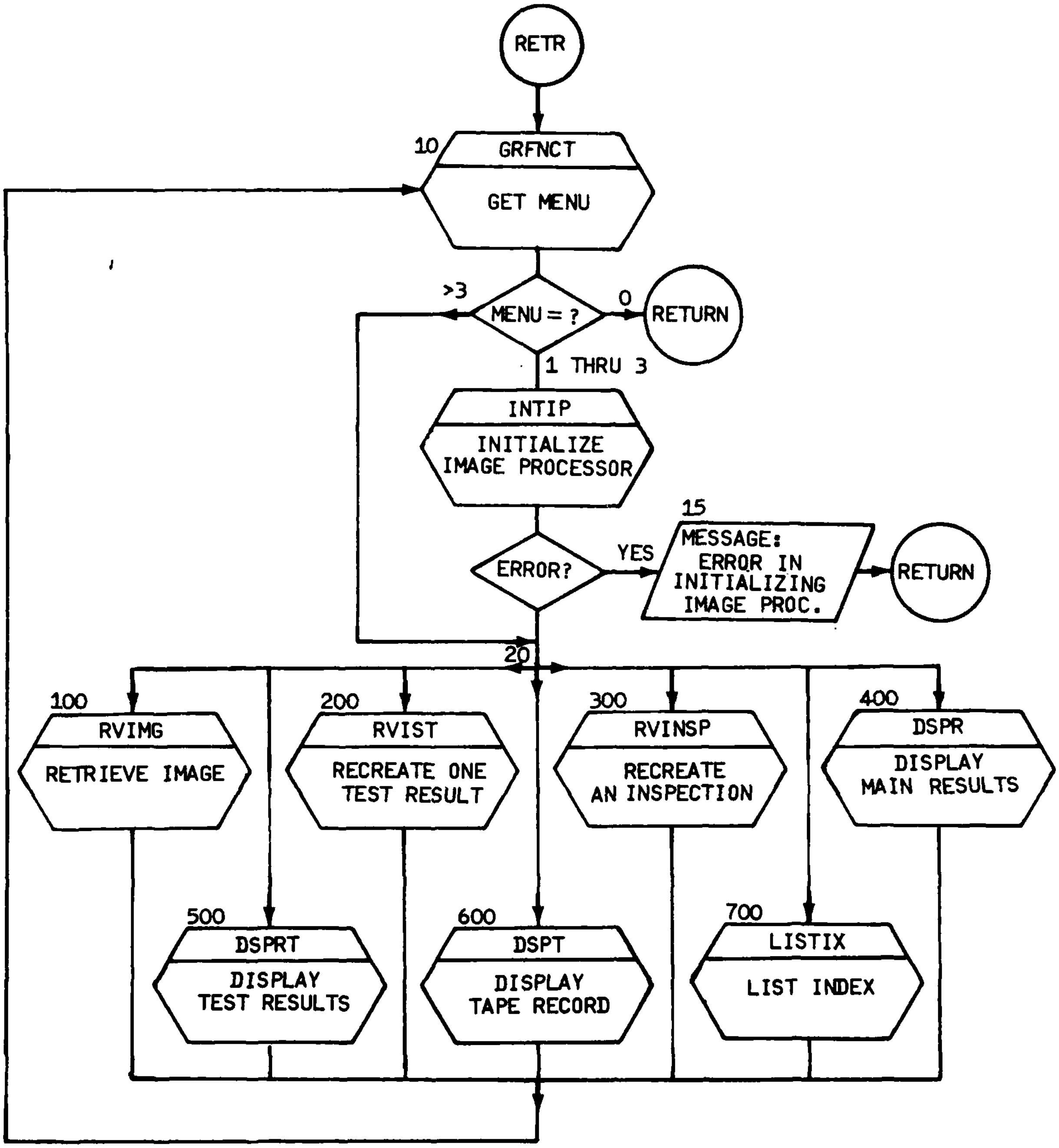
ARGUMENTS: 2
- INTEGER: ENCODER
- INTEGER: ERROR





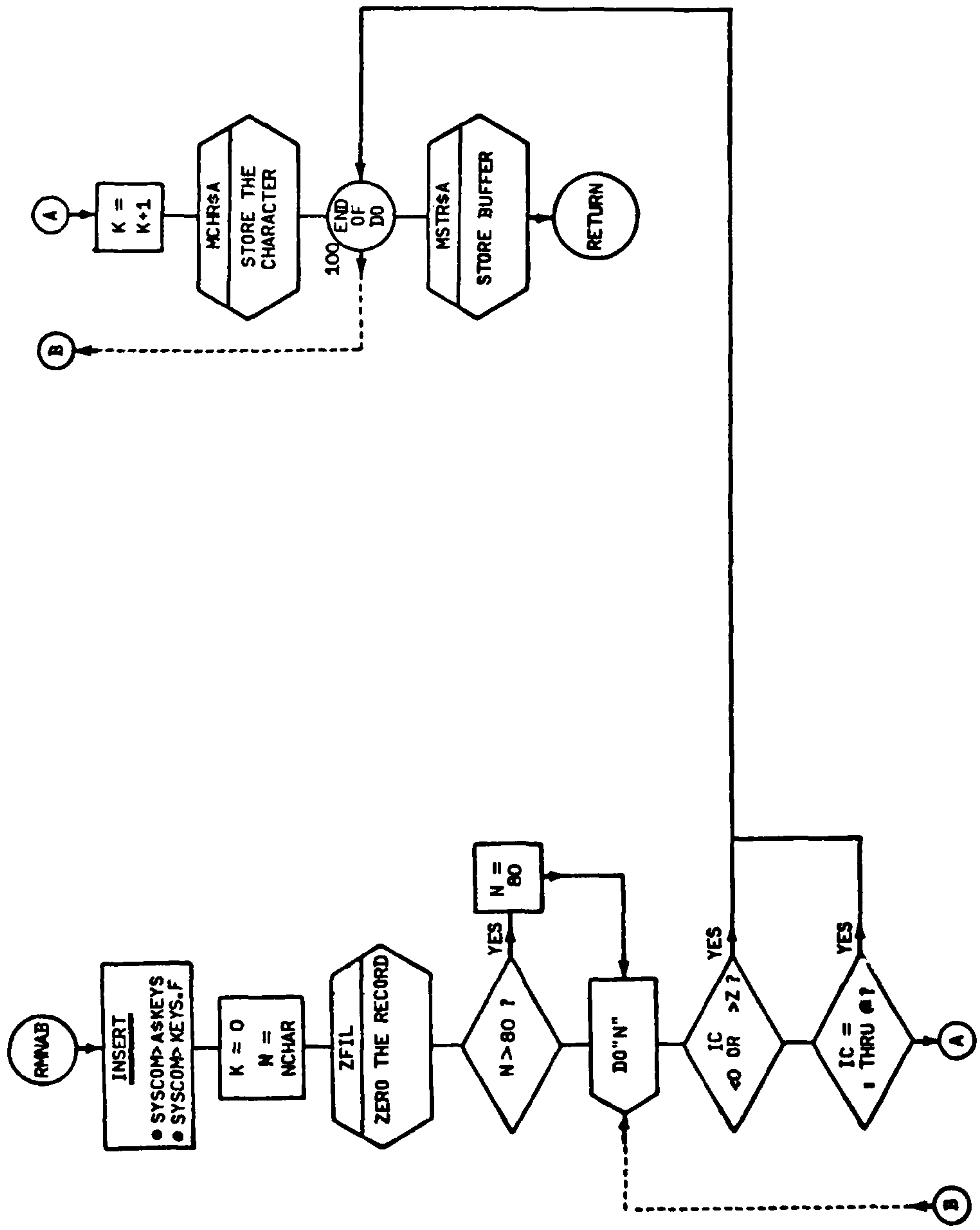
RETR - RETRIEVE HISTORICAL RECORD

ARGUMENTS: 2
INTEGER: ERROR
LOGICAL: EQUIPMENT



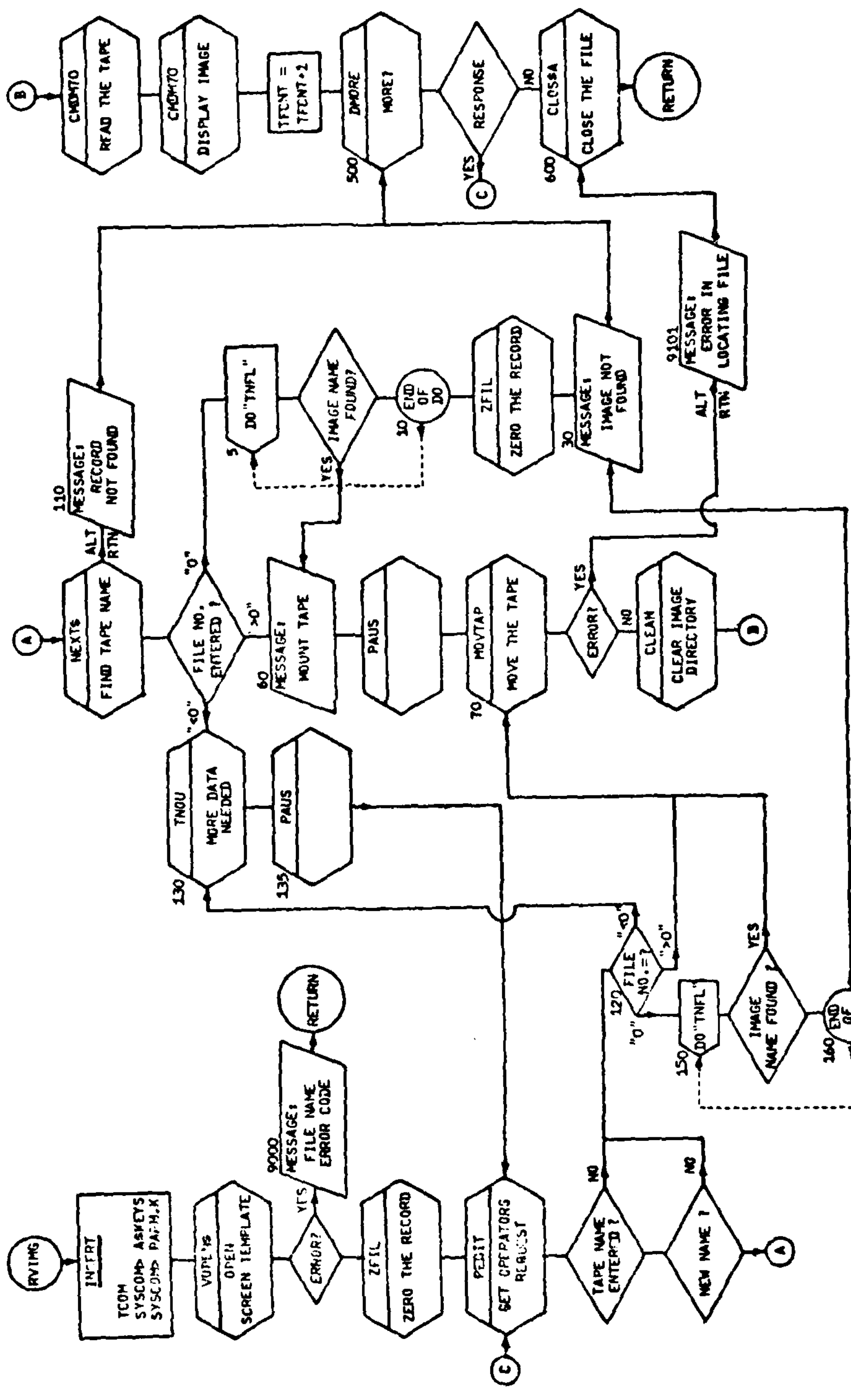
RMNAB - REMOVE NON-ALPAHBETICAL CHARACTERS

ARGUMENTS: 2
- STRING: TEXT
- INTEGER: NO. OF CHARACTERS



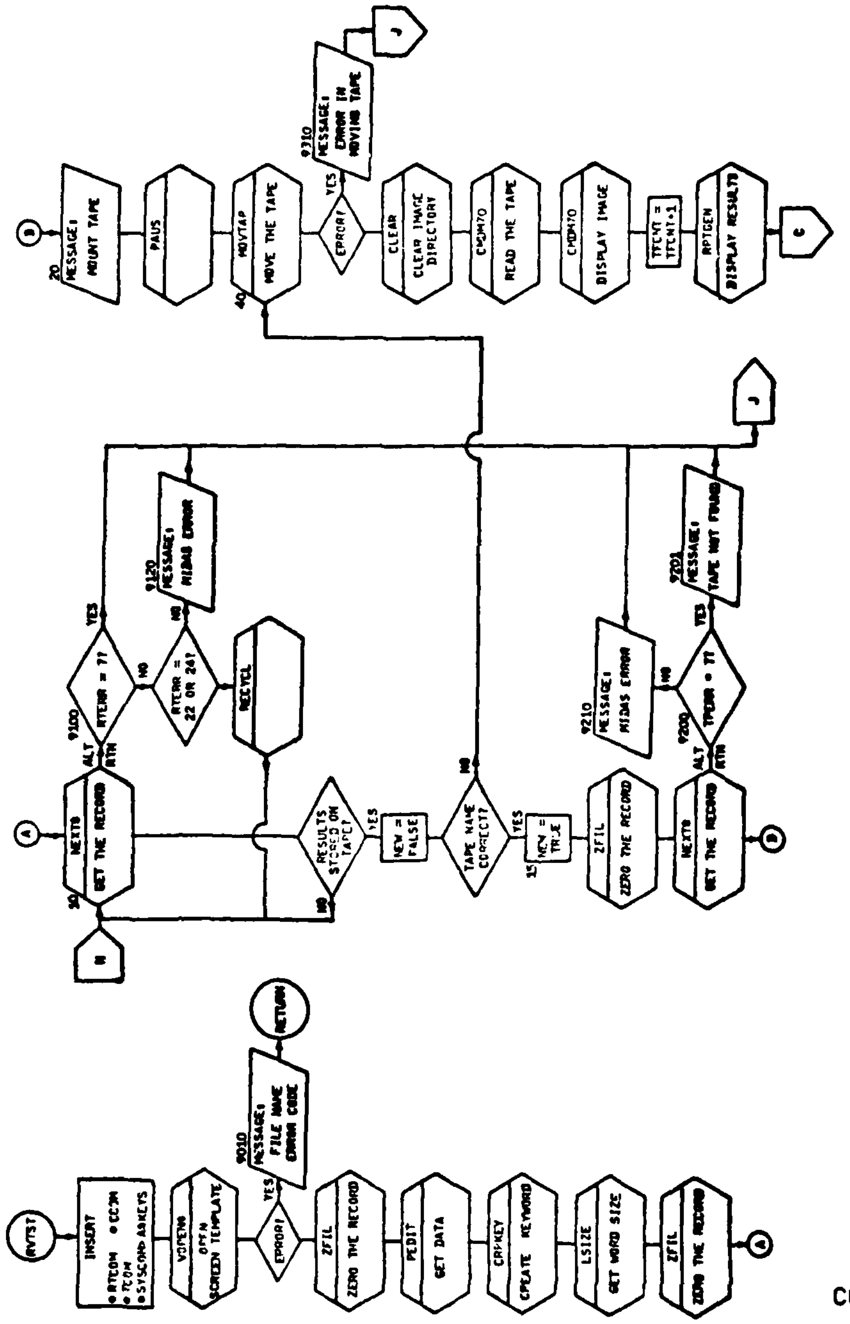
RVIMG - RETRIEVE AN IMAGE

ARGUMENTS: NONE



RVTST - RECREATE ONE TEST RESULT

ARGUMENTS: NONE



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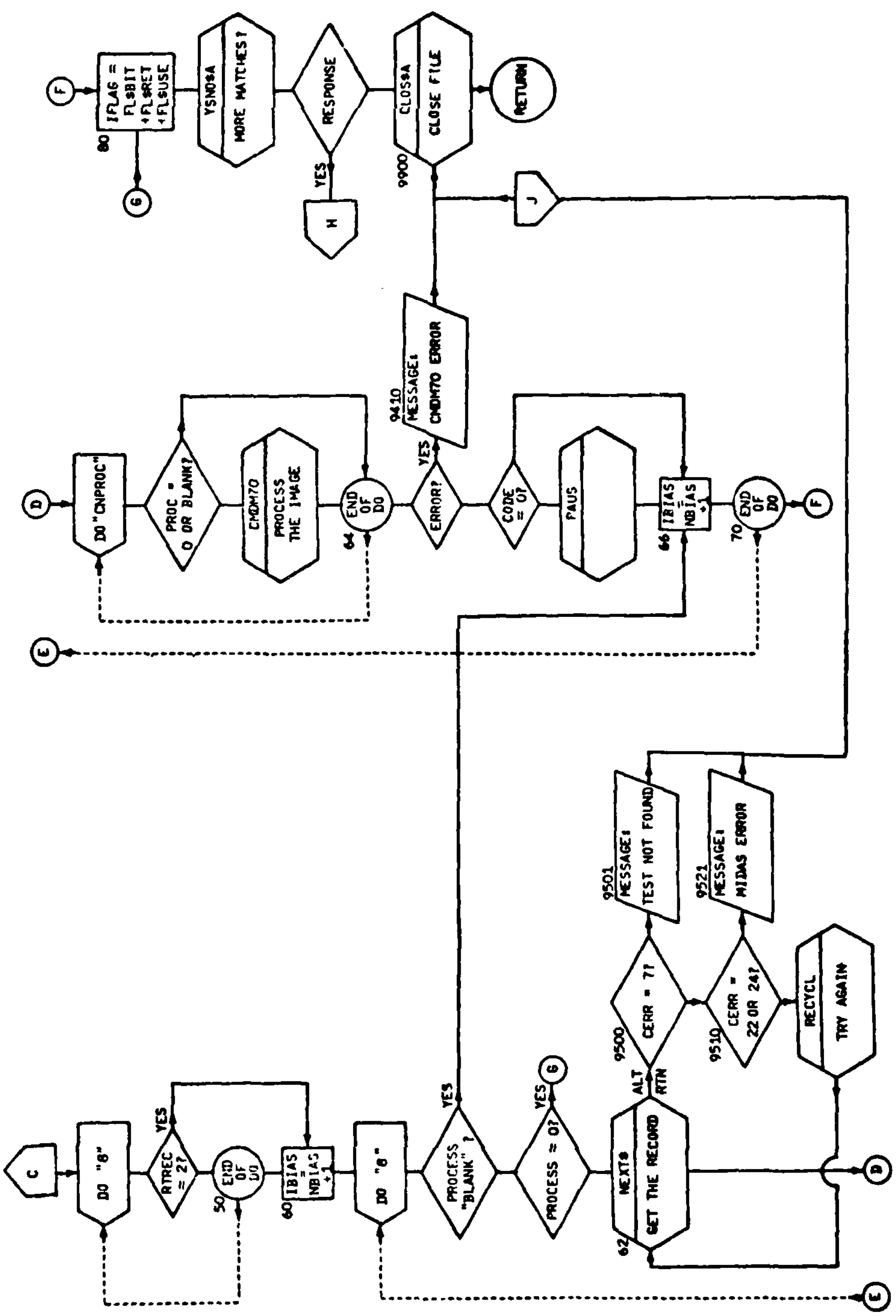
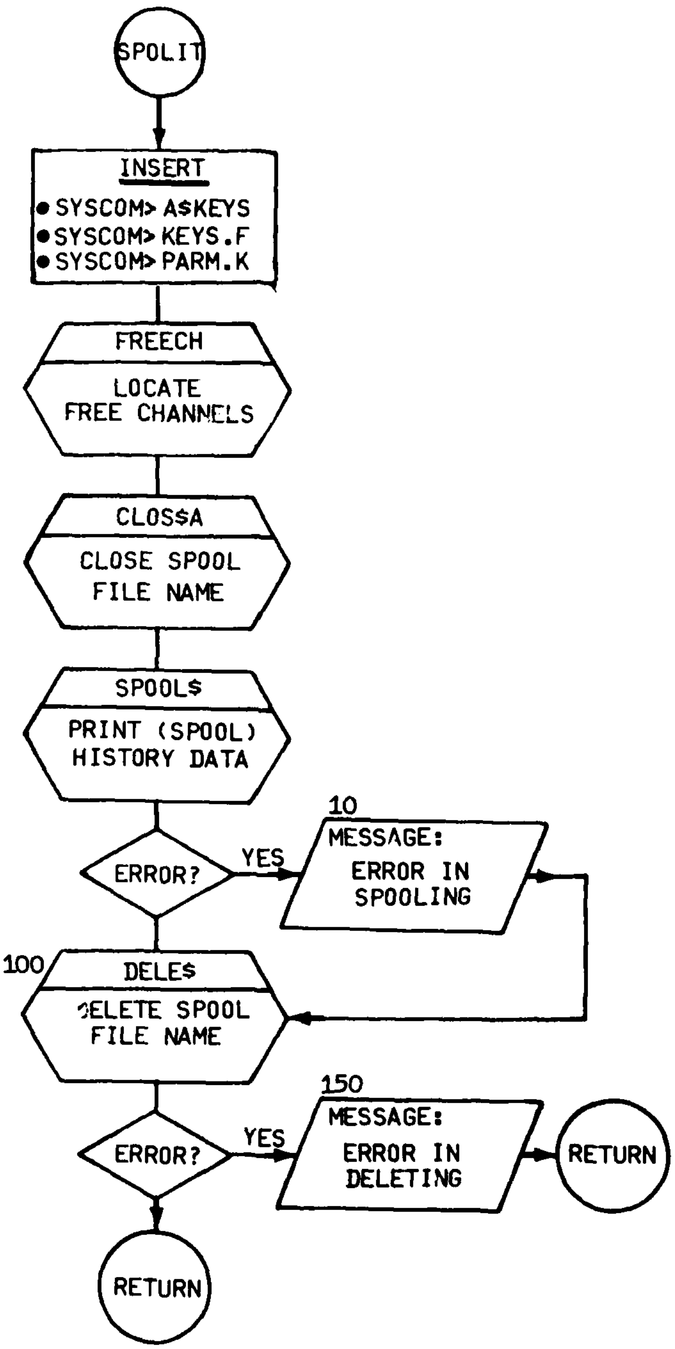
NEXT PAGE

RVTST - RECREATE ONE TEST RESULT (CONT'D)



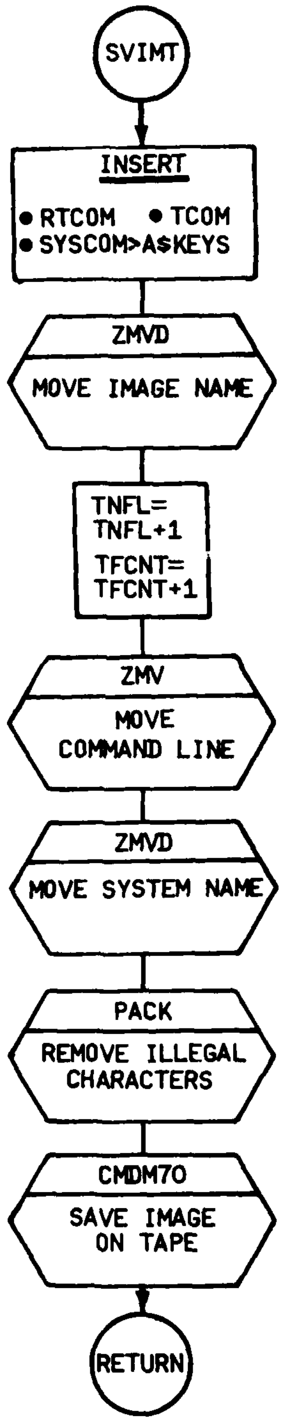
SPOLIT - SPOOL RETRIEVAL INFORMATION

ARGUMENTS: 2
- INTEGER: SPOOL CHANNEL
- STRING: SPOOL FILE NAME



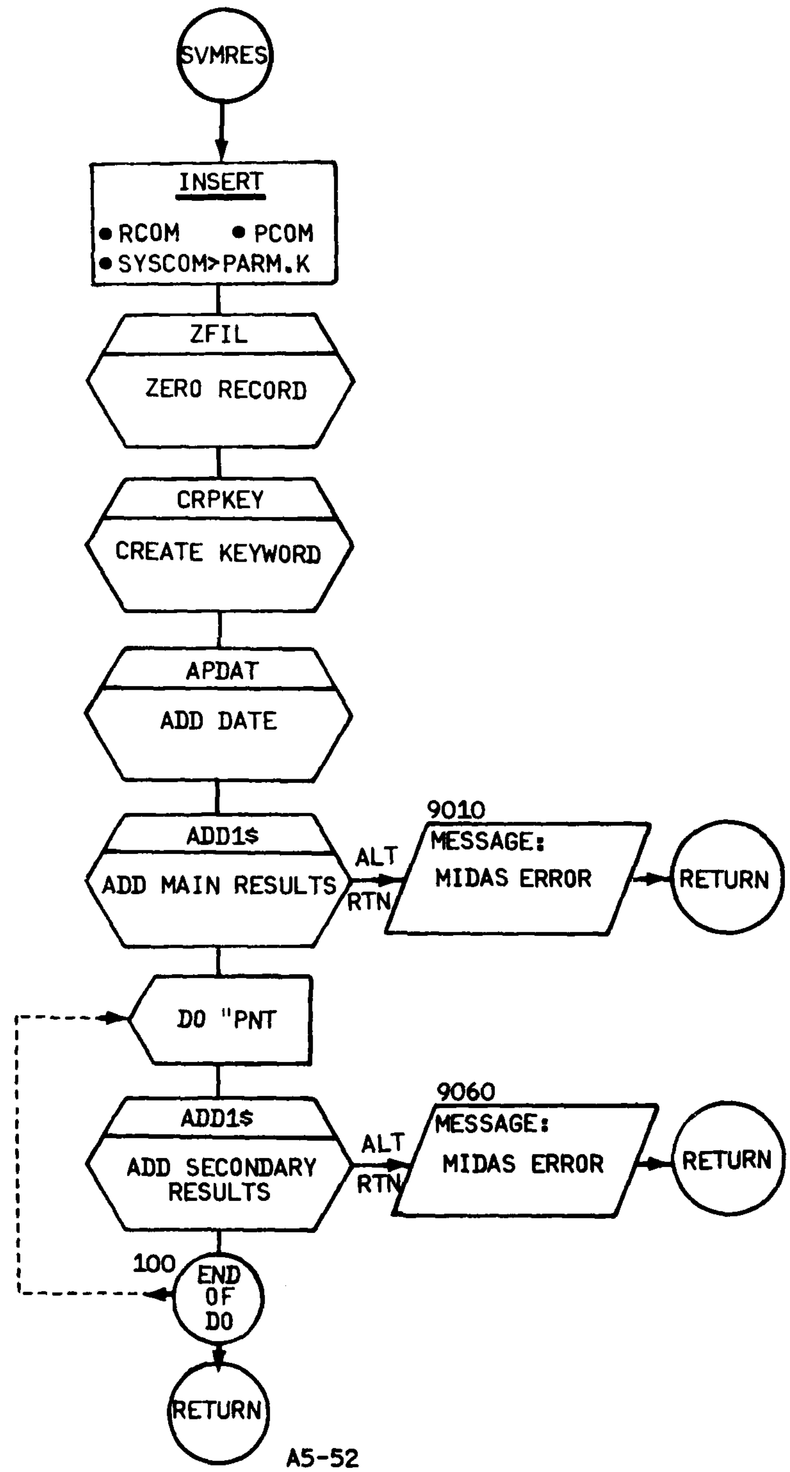
SVIMT - SAVE IMAGE ON TAPE

ARGUMENTS: 1
- STRING: SYSTEM IMAGE NAME



SVMRES - SAVE RESULTS - MAIN RECORD

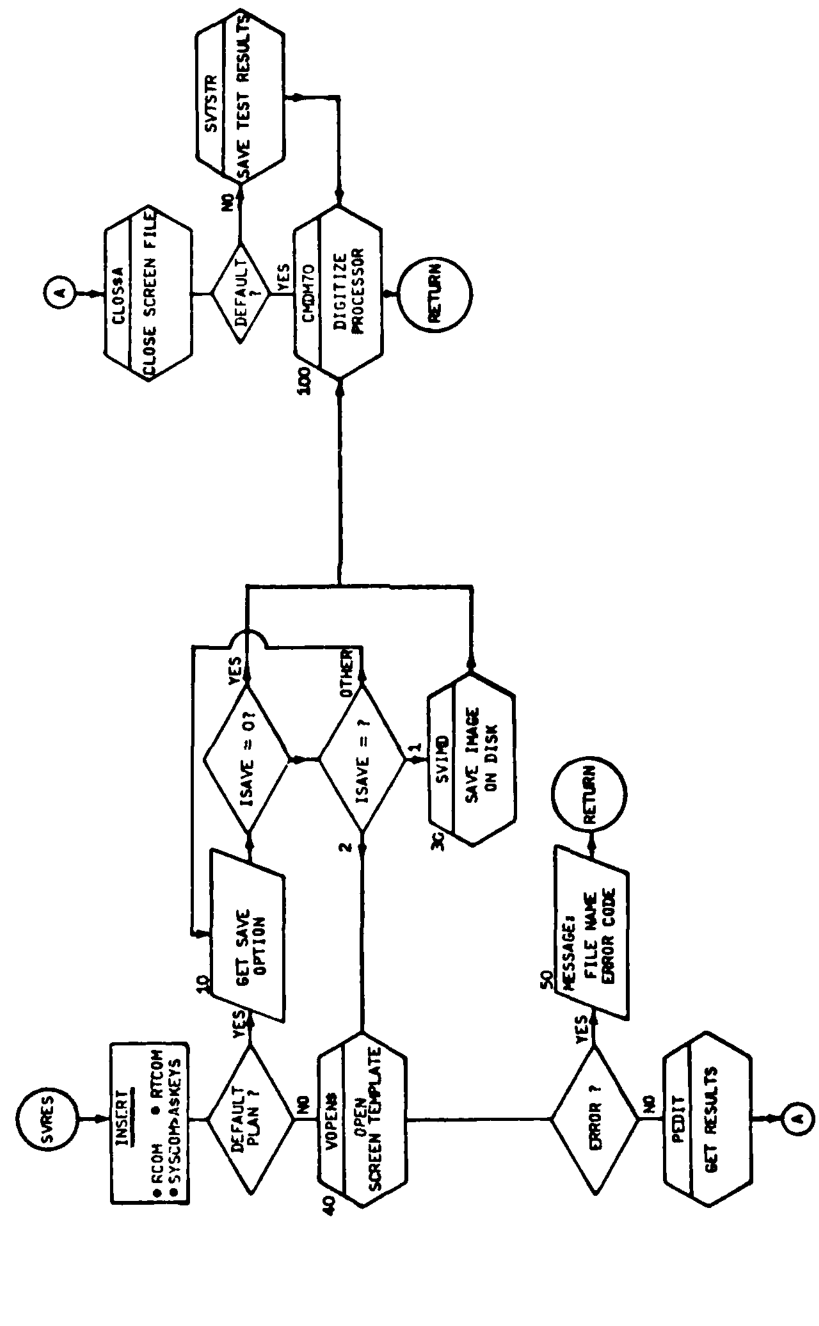
ARGUMENTS: 1
- INTEGER: ERROR



SVRES - SAVE RESULTS OF INSPECTION

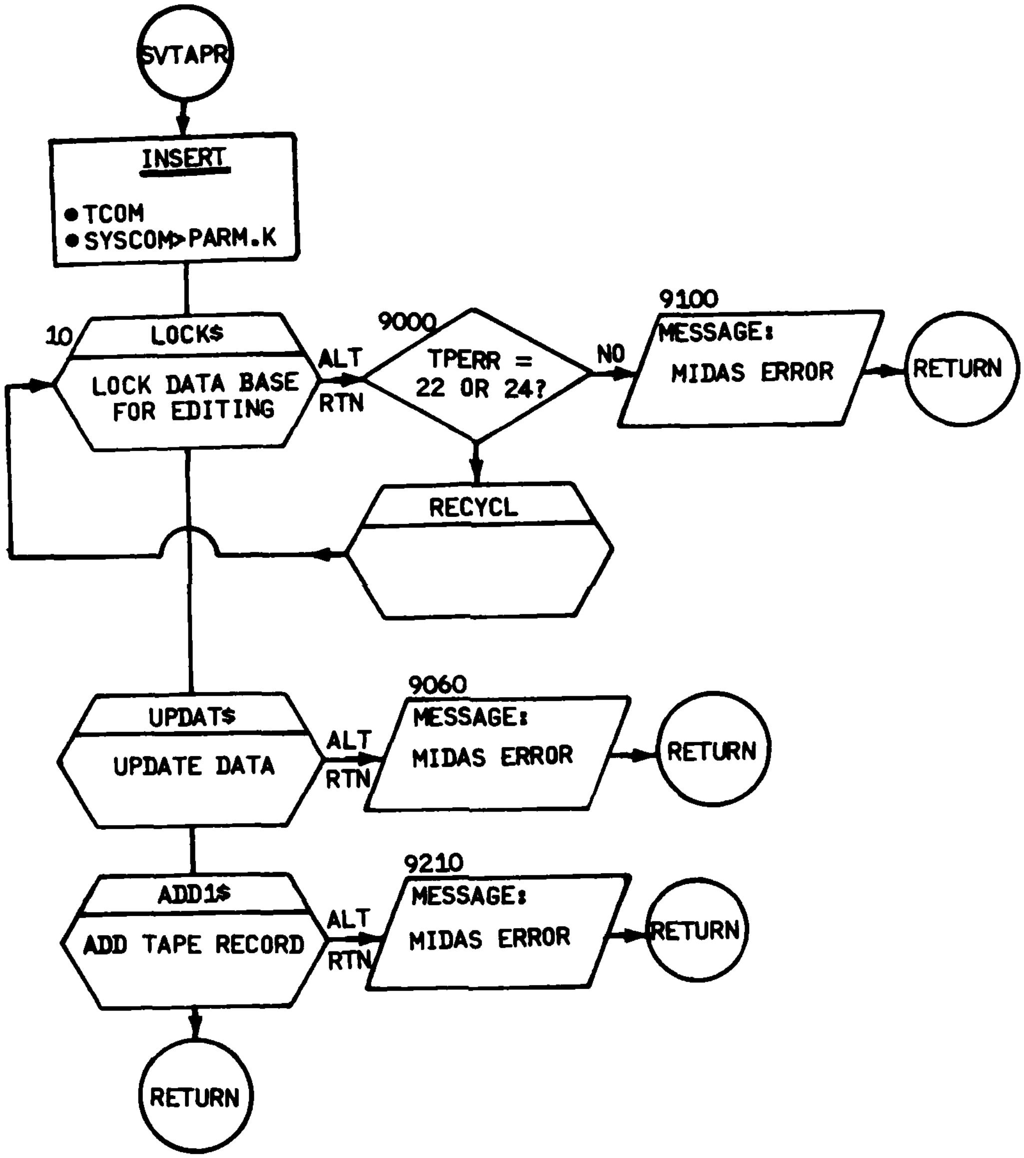
ARGUMENTS: 5

- LOGICAL: DEFAULT
- LOGICAL: NO TAPE
- INTEGER: LOOP
- INTEGER: RTKEY
- INTEGER: ERROR



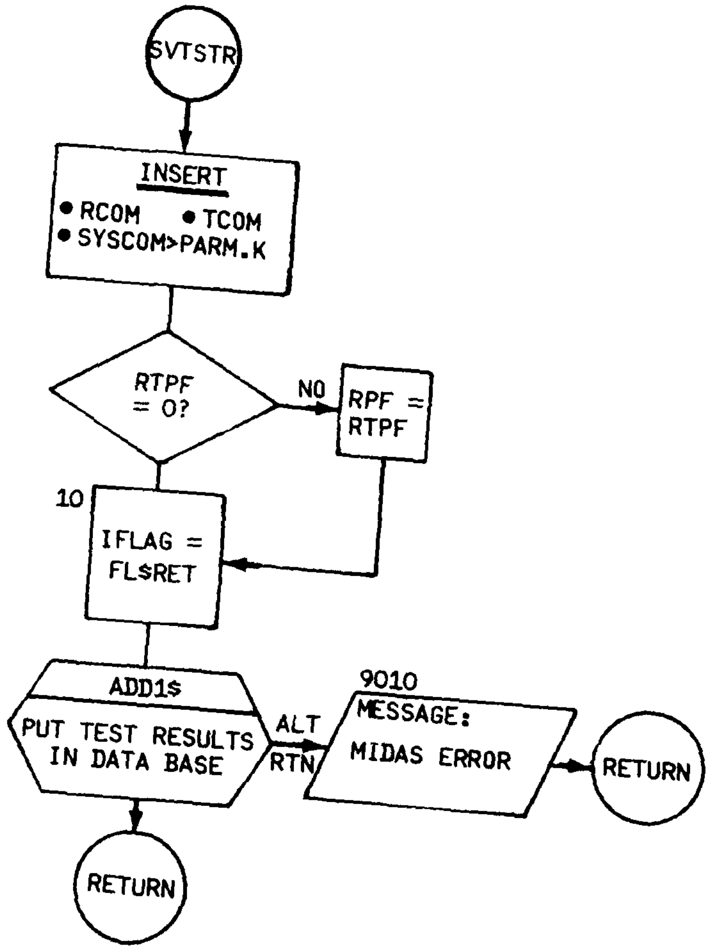
SVTAPR - SAVE THE TAPE RECORD (MIDAS)

ARGUMENTS: 1
- INTEGER: ERROR



SVTSTR - SAVE TEST RESULTS

ARGUMENTS: 2
- INTEGER: KEY
- INTEGER: ERROR



```
C  PCOM: COMMON FILE FOR PLAN DATA-BASE.
C
C    *************************************************************
C    *                                                           *
C    *         REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM      *
C    *         VERSION 1.0     JUNE 1,1980                       *
C    *         BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY     *
C    *                                                           *
C    *************************************************************
C
      INTEGER PSZW,PSZB,PNWT
      PARAMETER PNWT=10                 /* No. OF WORDS IN TEST NAME
      PARAMETER PSZW=10*PNWT+21         /* PLAN RECORD SIZE IN WORDS
      PARAMETER PSZB=PSZW*2             /* PLAN RECORD SIZE IN BYTES
C
      INTEGER PREC(PSZW)       /* PLAN RECORD
C
      INTEGER PPN(10)          /* PLAN PART No.
      INTEGER PIN(10)          /*  " INSPECTION NAME
      INTEGER PNT              /*  "   No. TESTS
      INTEGER PTNO1(PNWT)      /* TEST 01 NAME
      INTEGER PTNO2(PNWT)      /* TEST 02 NAME
      INTEGER PTNO3(PNWT)      /* TEST 03 NAME
      INTEGER PTNO4(PNWT)      /* TEST 04 NAME
      INTEGER PTNO5(PNWT)      /* TEST 05 NAME
      INTEGER PTNO6(PNWT)      /* TEST 06 NAME
      INTEGER PTNO7(PNWT)      /* TEST 07 NAME
      INTEGER PTNO8(PNWT)      /* TEST 08 NAME
      INTEGER PTNO9(PNWT)      /* TEST 09 NAME
      INTEGER PTN10(PNWT)      /* TEST 10 NAME
C
C
C   PRIMARY KEY: CONDENSATION OF PART-NUMBER AND INSPECTION NAME
C      WITH / SEPARATING THEM. 30 CHARACTERS LONG.
C   SECONDARY KEY: TEST NAMES.
C
C
      EQUIVALENCE (PREC(1),   PPN)        /* PLAN PART No.
      EQUIVALENCE (PREC(11),  PIN)        /*  " INSPECTION NAME
      EQUIVALENCE (PREC(21),  PNT)        /*  "  No. TESTS
      EQUIVALENCE (PREC(22),  PTNO1)      /* TEST 01 NAME
      EQUIVALENCE (PREC(32),  PTNO2)      /* TEST 02 NAME
      EQUIVALENCE (PREC(42),  PTNO3)      /* TEST 03 NAME
      EQUIVALENCE (PREC(52),  PTNO4)      /* TEST 04 NAME
      EQUIVALENCE (PREC(62),  PTNO5)      /* TEST 05 NAME
      EQUIVALENCE (PREC(72),  PTNO6)      /* TEST 06 NAME
      EQUIVALENCE (PREC(82),  PTNO7)      /* TEST 07 NAME
      EQUIVALENCE (PREC(92),  PTNO8)      /* TEST 08 NAME
      EQUIVALENCE (PREC(102), PTNO9)      /* TEST 09 NAME
      EQUIVALENCE (PREC(112), PTN10)      /* TEST 10 NAME
C
C   DATA-BASE NAME AND MIDAS INDEX POINTER ARRAY
      INTEGER PLNAM(16)        /* PLAN DATA FILE NAME
      INTEGER PLLEN            /* NAME LENGTH
      INTEGER PCHN             /* CHAN. TO DATA BASE FILE
      INTEGER PLARR(14)        /* MIDAS INFO ARRAY
      INTEGER PLERR            /* MIDAS ERROR CODE
C
      EQUIVALENCE (PLARR,PLERR)
      COMMON /PCOM/ PREC,PLNAM,PLLEN,PCHN,PLARR
```

```
C     PTCOM: PLAN TEST COMMON FILE
C
C      ***************************************************************
C      *                                                             *
C      *           REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM      *
C      *           VERSION 1.0     JUNE 1,1980                       *
C      *           BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY     *
C      *                                                             *
C      ***************************************************************
C
        INTEGER PTSZW,PTSZB,PNWM,PNWI,PNMOT,PNIMG
        PARAMETER PNMOT=5                 /* No. OF MOTOR COMMANDS
        PARAMETER PNIMG=10                /* No. OF IMAGE COMMANDS
        PARAMETER PNWM=2                  /* No. OF WORDS PER MOTOR COMMAND
        PARAMETER PNWI=41                 /* No. OF WORDS PER IMAGE COMMAND
        PARAMETER PTSZW=PNMOT*PNWM+PNIMG*PNWI+166
        PARAMETER PTSZB=PTSZW*2           /* No. OF BYTES IN PLAN TEST RECORD
C
        INTEGER PTREC(PTSZW)
C
        INTEGER PTNM(10)          /* TEST NAME
        INTEGER PDA(39)           /* DESCRIPTION LINE A
        INTEGER PDB(39)           /* DESCRIPTION LINE B
        INTEGER PDC(39)           /* DESCRIPTION LINE C
        INTEGER PDD(39)           /* DESCRIPTION LINE D
        INTEGER PKXP              /* MASK X POSITION
        INTEGER PKXS              /* MASK X SPEED
        INTEGER PKYP              /* MASK Y POSITION
        INTEGER PKYS              /* MASK Y SPEED
        INTEGER PMXP              /* TABLE X POSITION
        INTEGER PMXS              /* TABLE X SPEED
        INTEGER PMYP              /* TABLE Y POSITION
        INTEGER PMYS              /* TABLE Y SPEED
        INTEGER PMRP              /* ROTATE POSITION
        INTEGER PMRS              /* ROTATE SPEED
        INTEGER PIPA(40)          /* IMAGE PROCESS A
        INTEGER PNXA              /* CODE FOR NEXT OPERATION
        INTEGER PIPB(40)          /* IMAGE PROCESS B
        INTEGER PNXB              /* CODE FOR NEXT OPERATION
        INTEGER PIPC(40)          /* IMAGE PROCESS C
        INTEGER PNXC              /* CODE FOR NEXT OPERATION
        INTEGER PIPD(40)          /* IMAGE PROCESS D
        INTEGER PNXD              /* CODE FOR NEXT OPERATION
        INTEGER PIPE(40)          /* IMAGE PROCESS E
        INTEGER PNXE              /* CODE FOR NEXT OPERATION
        INTEGER PIPF(40)          /* IMAGE PROCESS F
        INTEGER PNXF              /* CODE FOR NEXT OPERATION
        INTEGER PIPG(40)          /* IMAGE PROCESS G
        INTEGER PNXG              /* CODE FOR NEXT OPERATION
        INTEGER PIPH(40)          /* IMAGE PROCESS H
        INTEGER PNXH              /* CODE FOR NEXT OPERATION
C
C     PRIMARY KEY = PTNM (1st. ELEMENT, 20 CHAR.)
C     SECONDARY KEY = NONE.
C
        EQUIVALENCE (PTREC(1),   PTNM)    /* TEST NAME
        EQUIVALENCE (PTREC(11),  PDA)     /* DESCRIPTION LINE A
        EQUIVALENCE (PTREC(50),  PDB)     /* DESCRIPTION LINE B
        EQUIVALENCE (PTREC(89),  PDC)     /* DESCRIPTION LINE C
        EQUIVALENCE (PTREC(128),PDD)      /* DESCRIPTION LINE D
        EQUIVALENCE (PTREC(167),PKXP)     /* MASK X POSITION
        EQUIVALENCE (PTREC(168),PKXS)     /* MASK X SPEED
        EQUIVALENCE (PTREC(169),PKYP)     /* MASK Y POSITION
        EQUIVALENCE (PTREC(170),PKYS)     /* MASK Y SPEED
        EQUIVALENCE (PTREC(171),PMXP)     /* TABLE X POSITION
        EQUIVALENCE (PTREC(172),PMXS)     /* TABLE X SPEED
        EQUIVALENCE (PTREC(173),PMYP)     /* TABLE Y POSITION
        EQUIVALENCE (PTREC(174),PMYS)     /* TABLE Y SPEED
        EQUIVALENCE (PTREC(175),PMRP)     /* ROTATE POSITION
        EQUIVALENCE (PTREC(176),PMRS)     /* ROTATE SPEED
        EQUIVALENCE (PTREC(177),PIPA)     /* IMAGE PROCESS A
        EQUIVALENCE (PTREC(217),PNXA)     /* CODE FOR NEXT OPERATION
        EQUIVALENCE (PTREC(218),PIPB)     /* IMAGE PROCESS B
        EQUIVALENCE (PTREC(258),PNXB)     /* CODE FOR NEXT OPERATION
        EQUIVALENCE (PTREC(259),PIPC)     /* IMAGE PROCESS C
```

```
      EQUIVALENCE (PTREC(299),PNXC)   /* CODE FOR NEXT OPERATION
      EQUIVALENCE (PTREC(300),PIPD)   /* IMAGE PROCESS D
      EQUIVALENCE (PTREC(340),PNXD)   /* CODE FOR NEXT OPERATION
      EQUIVALENCE (PTREC(341),PIPE)   /* IMAGE PROCESS E
      EQUIVALENCE (PTREC(381),PNXE)   /* CODE FOR NEXT OPERATION
      EQUIVALENCE (PTREC(382),PIPF)   /* IMAGE PROCESS F
      EQUIVALENCE (PTREC(422),PNXF)   /* CODE FOR NEXT OPERATION
      EQUIVALENCE (PTREC(423),PIPG)   /* IMAGE PROCESS G
      EQUIVALENCE (PTREC(463),PNXG)   /* CODE FOR NEXT OPERATION
      EQUIVALENCE (PTREC(464),PIPH)   /* IMAGE PROCESS H
      EQUIVALENCE (PTREC(504),PNXH)   /* CODE FOR NEXT OPERATION
C
C    DATA-BASE NAME AND MIDAS INDEX POINTER ARRAY
      INTEGER PTNAM(16)       /* PLAN TEST DATA FILE NAME
      INTEGER PTLEN           /* NAME LENGTH
      INTEGER PTCHN           /* CHAN. TO DATA BASE FILE
      INTEGER PTARR(14)       /* MIDAS INFO ARRAY
      INTEGER PTERR           /* MIDAS ERROR CODE
C
      EQUIVALENCE (PTARR,PTERR)
      COMMON /PTCOM/ PTREC,PTNAM,PTLEN,PTCHN,PTARR
```

```
C     CCOM: COMMAND LIBRARY COMMON FILE
C
C      ******************************************************************
C      *                                                                *
C      *           REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM         *
C      *           VERSION 1.0     JUNE 1,1980                          *
C      *           BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY        *
C      *                                                                *
C      ******************************************************************
C
        INTEGER CNPROC,CNWI,CSZW,CSZB
        PARAMETER CNPROC=10               /* NO. OF PROCESSES FOR THIS COMMAND
        PARAMETER CNWI=40                 /* NO. OF WORDS PER PROCESS LINE
        PARAMETER CSZW=CNPROC*CNWI+10     /* NO. OF WORDS PER RECORD
        PARAMETER CSZB=CSZW*2             /* NO. OF BYTES PER RECORD
C
        INTEGER CREC(CSZW)
C
        INTEGER CNAM(10)             /*COMMAND NAME
        INTEGER PROC1(CNWI)          /* FIRST PROCESS COMMAND LINE
        INTEGER PROC2(CNWI)          /* 2ND PROCESS COMMAND LINE
        INTEGER PROC3(CNWI)          /* 3RD PROCESS COMMAND LINE
        INTEGER PROC4(CNWI)          /* 4TH PROCESS COMMAND LINE
        INTEGER PROC5(CNWI)          /* 5TH PROCESS COMMAND LINE
        INTEGER PROC6(CNWI)          /* 6TH PROCESS COMMAND LINE
        INTEGER PROC7(CNWI)          /* 7TH PROCESS COMMAND LINE
        INTEGER PROC8(CNWI)          /* 8TH PROCESS COMMAND LINE
        INTEGER PROC9(CNWI)          /* 9TH PROCESS COMMAND LINE
        INTEGER PROC10(CNWI)         /*10TH PROCESS COMMAND LINE
C
C     PRIMARY KEY = CNAM (1st. ELEMENT, 20 CHAR.)
C     SECONDARY KEY = NONE.
C
        EQUIVALENCE (CREC(1),   CNAM)         /* COMMAND NAME
        EQUIVALENCE (CREC(11),  PROC1)        /* FIRST PROCESS COMMAND LINE
        EQUIVALENCE (CREC(51),  PROC2)        /* 2ND PROCESS COMMAND LINE
        EQUIVALENCE (CREC(91),  PROC3)        /* 3RD PROCESS COMMAND LINE
        EQUIVALENCE (CREC(131), PROC4)        /* 4TH PROCESS COMMAND LINE
        EQUIVALENCE (CREC(171), PROC5)        /* 5TH PROCESS COMMAND LINE
        EQUIVALENCE (CREC(211), PROC6)        /* 6TH PROCESS COMMAND LINE
        EQUIVALENCE (CREC(251), PROC7)        /* 7TH PROCESS COMMAND LINE
        EQUIVALENCE (CREC(291), PROC8)        /* 8TH PROCESS COMMAND LINE
        EQUIVALENCE (CREC(331), PROC9)        /* 9TH PROCESS COMMAND LINE
        EQUIVALENCE (CREC(371), PROC10)       /* 10TH PROCESS COMMAND LINE
C
C     DATA-BASE NAME AND MIDAS INDEX POINTER ARRAY
        INTEGER CNNAM(16)          /* COMMAND DATA FILE NAME
        INTEGER CLEN              /* NAME LENGTH
        INTEGER CCHN              /* CHAN. TO DATA BASE FILE
        INTEGER CARR(14)          /* MIDAS INFO ARRAY
        INTEGER CERR              /* MIDAS ERROR CODE
C
        EQUIVALENCE (CARR,CERR)
        COMMON /CCOM/ CREC,CNNAM,CLEN,CCHN,CARR
```

```
C   RCOM: COMMON FILE FOR RESULTS DATA-BASE.
C
C     ****************************************************************
C     *                                                              *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C     *          VERSION 1.0     JUNE 1,1980                         *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C     *                                                              *
C     ****************************************************************
C
        INTEGER RSZW,RSZB,RNWT,RNT
        PARAMETER RNT=10                 /* No. TESTS
        PARAMETER RNWT=25                /* No. OF WORDS IN TEST NAME
        PARAMETER RSZW=RNT*RNWT+42       /* RESULTS RECORD SIZE IN WORDS
        PARAMETER RSZB=RSZW*2            /* RESULTS RECORD SIZE IN BYTES
C
        INTEGER RREC(RSZW)         /* RESULTS RECORD
C
        INTEGER RPN(10)            /* RESULTS PART No.
        INTEGER RIN(10)            /* INSPECTION NAME
        INTEGER RSNO(10)           /* SERIAL No.
        INTEGER RIID(5)            /* INSPECTOR'S ID
        INTEGER RDATI(6)           /* DATE-TIME
        INTEGER RPF                /* PASS-FAIL CODE
        INTEGER RTN01(RNWT)        /* TEST 01 NAME
        INTEGER RTN02(RNWT)        /* TEST 02 NAME
        INTEGER RTN03(RNWT)        /* TEST 03 NAME
        INTEGER RTN04(RNWT)        /* TEST 04 NAME
        INTEGER RTN05(RNWT)        /* TEST 05 NAME
        INTEGER RTN06(RNWT)        /* TEST 06 NAME
        INTEGER RTN07(RNWT)        /* TEST 07 NAME
        INTEGER RTN08(RNWT)        /* TEST 08 NAME
        INTEGER RTN09(RNWT)        /* TEST 09 NAME
        INTEGER RTN10(RNWT)        /* TEST 10 NAME
C
C    PRIMARY KEY: CONDENSATION OF PART-NUMBER, INSP. NAME, & SERIAL NO.
C       SEPARATED BY "/".  40 CHARACTERS LONG.
C    SECONDARY KEY: TEST NAMES
C
C
        EQUIVALENCE (RREC(1),   RPN)          /* RESULTS PART No.
        EQUIVALENCE (RREC(11),  RIN)          /* INSPECTION NAME
        EQUIVALENCE (RREC(21),  RSNO)         /* SERIAL No.
        EQUIVALENCE (RREC(31),  RIID)         /* INSPECTOR'S ID
        EQUIVALENCE (RREC(36),  RDATI)        /* DATE-TIME
        EQUIVALENCE (RREC(42),  RPF)          /* PASS-FAIL CODE
        EQUIVALENCE (RREC(43),  RTN01)        /* TEST 01 NAME
        EQUIVALENCE (RREC(68),  RTN02)        /* TEST 02 NAME
        EQUIVALENCE (RREC(93),  RTN03)        /* TEST 03 NAME
        EQUIVALENCE (RREC(118), RTN04)        /* TEST 04 NAME
        EQUIVALENCE (RREC(143), RTN05)        /* TEST 05 NAME
        EQUIVALENCE (RREC(168), RTN06)        /* TEST 06 NAME
        EQUIVALENCE (RREC(193), RTN07)        /* TEST 07 NAME
        EQUIVALENCE (RREC(218), RTN08)        /* TEST 08 NAME
        EQUIVALENCE (RREC(243), RTN09)        /* TEST 09 NAME
        EQUIVALENCE (RREC(268), RTN10)        /* TEST 10 NAME
C
C    DATA-BASE NAME AND MIDAS INDEX POINTER ARRAY
        INTEGER RLNAM(16)          /* RESULTS DATA FILE NAME
        INTEGER RLLEN              /* NAME LENGTH
        INTEGER RLCHN               /* CHAN. TO DATA BASE FILE
        INTEGER RLARR(14)          /* MIDAS INFO ARRAY
        INTEGER RLERR              /* MIDAS ERROR CODE
C
        EQUIVALENCE (RLARR,RLERR)
        COMMON /RCOM/ RREC,RLNAM,RLLEN,RLCHN,RLARR
C
```

```
C   RTCOM: TEST RESULTS COMMON FILE
C
C    ***************************************************************
C    *                                                             *
C    *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C    *          VERSION 1.0     JUNE 1,1980                        *
C    *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C    *                                                             *
C    ***************************************************************
C
      INTEGER RTSZW,RTSZB,RNWM,RNWI,RNMOT,RNIMG
      PARAMETER RNMOT=5                /* No. OF MOTOR COMMANDS
      PARAMETER RNIMG=10               /* No. OF IMAGE COMMANDS
      PARAMETER RNWM=2                 /* No. OF WORDS PER MOTOR COMMAND
      PARAMETER RNWI=41                /* No. OF WORDS PER IMAGE COMMAND
      PARAMETER RTSZW=RNMOT*RNWM+RNIMG*RNWI+298
      PARAMETER RTSZB=RTSZW*2          /* No. OF BYTES IN PLAN TEST RECORD
C
      INTEGER RTREC(RTSZW)
C
      INTEGER RTNM(10)          /* TEST NAME
      INTEGER RDA(39)           /* DESCRIRTION LINE A
      INTEGER RDB(39)           /* DESCRIRTION LINE B
      INTEGER RDC(39)           /* DESCRIRTION LINE C
      INTEGER RDD(39)           /* DESCRIRTION LINE D
      INTEGER RKXP              /* MASK X POSITION
      INTEGER RKXS              /* MASK X SPEED
      INTEGER RKYP              /* MASK Y POSITION
      INTEGER RKYS              /* MASK Y SPEED
      INTEGER RMXP              /* TABLE X POSITION
      INTEGER RMXS              /* TABLE X SPEED
      INTEGER RMYP              /* TABLE Y POSITION
      INTEGER RMYS              /* TABLE Y SPEED
      INTEGER RMRP              /* ROTATE POSITION
      INTEGER RMRS              /* ROTATE SPEED
      INTEGER RIPA(40)          /* IMAGE PROCESS A
      INTEGER RNXA              /* CODE FOR NEXT OPERATION
      INTEGER RIPB(40)          /* IMAGE PROCESS B
      INTEGER RNXB              /* CODE FOR NEXT OPERATION
      INTEGER RIPC(40)          /* IMAGE PROCESS C
      INTEGER RNXC              /* CODE FOR NEXT OPERATION
      INTEGER RIPD(40)          /* IMAGE PROCESS D
      INTEGER RNXD              /* CODE FOR NEXT OPERATION
      INTEGER RIPE(40)          /* IMAGE PROCESS E
      INTEGER RNXE              /* CODE FOR NEXT OPERATION
      INTEGER RIPF(40)          /* IMAGE PROCESS F
      INTEGER RNXF              /* CODE FOR NEXT OPERATION
      INTEGER RIPG(40)          /* IMAGE PROCESS G
      INTEGER RNXG              /* CODE FOR NEXT OPERATION
      INTEGER RIPH(40)          /* IMAGE PROCESS H
      INTEGER RNXH              /* CODE FOR NEXT OPERATION
      INTEGER RTRKY(20)         /* RESULTS KEY
      INTEGER RTPF              /* PASS-FAIL CODE
      INTEGER RTCM1(40)         /* COMMENT LINE 1
      INTEGER RTCM2(40)         /* COMMENT LINE 2
      INTEGER RTTNM(10)         /* TAPE NAME
      INTEGER RTFNM             /* FILE No.
      INTEGER RTIMN(25)         /* IMAGE NAME
C
C   PRIMARY KEY = SAME AS TEST NAME FROM RREC, AND RTIMN
C   SECONDARY KEYS = NONE.
C
      EQUIVALENCE (RTREC(1),  RTNM)    /* TEST NAME
      EQUIVALENCE (RTREC(11), RDA)     /* DESCRIPTION LINE A
      EQUIVALENCE (RTREC(50), RDB)     /* DESCRIPTION LINE B
      EQUIVALENCE (RTREC(89), RDC)     /* DESCRIPTION LINE C
      EQUIVALENCE (RTREC(128),RDD)     /* DESCRIPTION LINE D
      EQUIVALENCE (RTREC(167),RKXP)    /* MASK X POSITION
      EQUIVALENCE (RTREC(168),RKXS)    /* MASK X SPEED
      EQUIVALENCE (RTREC(169),RKYP)    /* MASK Y POSITION
      EQUIVALENCE (RTREC(170),RKYS)    /* MASK Y SPEED
      EQUIVALENCE (RTREC(171),RMXP)    /* TABLE X POSITION
      EQUIVALENCE (RTREC(172),RMXS)    /* TABLE X SPEED
      EQUIVALENCE (RTREC(173),RMYP)    /* TABLE Y POSITION
      EQUIVALENCE (RTREC(174),RMYS)    /* TABLE Y SPEED
```

```
      EQUIVALENCE (RTREC(175),RMRP)   /* ROTATE POSITION
      EQUIVALENCE (RTREC(176),RMRS)   /* ROTATE SPEED
      EQUIVALENCE (RTREC(177),RIPA)   /* IMAGE PROCESS A
      EQUIVALENCE (RTREC(217),RNXA)   /* CODE FOR NEXT OPERATION
      EQUIVALENCE (RTREC(218),RIPB)   /* IMAGE PROCESS B
      EQUIVALENCE (RTREC(258),RNXB)   /* CODE FOR NEXT OPERATION
      EQUIVALENCE (RTREC(259),RIPC)   /* IMAGE PROCESS C
      EQUIVALENCE (RTREC(299),RNXC)   /* CODE FOR NEXT OPERATION
      EQUIVALENCE (RTREC(300),RIPD)   /* IMAGE PROCESS D
      EQUIVALENCE (RTREC(340),RNXD)   /* CODE FOR NEXT OPERATION
      EQUIVALENCE (RTREC(341),RIPE)   /* IMAGE PROCESS E
      EQUIVALENCE (RTREC(381),RNXE)   /* CODE FOR NEXT OPERATION
      EQUIVALENCE (RTREC(382),RIPF)   /* IMAGE PROCESS F
      EQUIVALENCE (RTREC(422),RNXF)   /* CODE FOR NEXT OPERATION
      EQUIVALENCE (RTREC(423),RIPG)   /* IMAGE PROCESS G
      EQUIVALENCE (RTREC(463),RNXG)   /* CODE FOR NEXT OPERATION
      EQUIVALENCE (RTREC(464),RIPH)   /* IMAGE PROCESS H
      EQUIVALENCE (RTREC(504),RNXH)   /* CODE FOR NEXT OPERATION
      EQUIVALENCE (RTREC(505),RTRKY)  /* KEY FOR RESULTS RECORD
      EQUIVALENCE (RTREC(525),RTPF)   /* PASS-FAIL CODE
      EQUIVALENCE (RTREC(526),RTCM1)  /* COMMENT 1
      EQUIVALENCE (RTREC(566),RTCM2)  /* COMMENT 2
      EQUIVALENCE (RTREC(606),RTTNM)  /* TAPE NAME
      EQUIVALENCE (RTREC(616),RTFNM)  /* FILE #
      EQUIVALENCE (RTREC(617),RTIMN)  /* IMAGE NAME
C
C   DATA-BASE NAME AND MIDAS INDEX POINTER ARRAY
      INTEGER RTNAM(16)        /* PLAN TEST DATA FILE NAME
      INTEGER RTLEN            /* NAME LENGTH
      INTEGER RTCHN            /* CHAN. TO DATA BASE FILE
      INTEGER RTARR(14)        /* MIDAS INFO ARRAY
      INTEGER RTERR            /* MIDAS ERROR CODE
C
      EQUIVALENCE (RTARR,RTERR)
      COMMON /RTCOM/ RTREC,RTNAM,RTLEN,RTCHN,RTARR
```

```
C  TCOM: COMMON FILE FOR TAPE DATA-BASE.
C
       INTEGER TSZW,TSZB,TNWT
       PARAMETER TNWT=25              /* No. OF WORDS IN TEST-RESULTS NAME
       PARAMETER TSZW=TNWT*52+11      /* TAPE RECORD SIZE IN WORDS
       PARAMETER TSZB=TSZW*2          /* TAPE RECORD SIZE IN BYTES
C
       INTEGER TREC(TSZW)      /* TAPE RECORD
C
       INTEGER TNAM(10)        /* TAPE NAME
       INTEGER TNFL            /* No. FILES RECORDED ON THIS TAPE
       INTEGER TIMNA(TNWT)     /* IMAGE A NAME
C
C
C   PRIMARY KEY: TAPE NAME
C   SECONDARY KEY: IMAGE NAME = TEST-RESULTS KEYWORD.
C
C
       EQUIVALENCE (TREC(1), TNAM)     /* TAPE NAME
       EQUIVALENCE (TREC(11),TNFL)     /* No. OF ENTRIES THIS FILE
       EQUIVALENCE (TREC(12),TIMNA)    /* IMAGE NAME
C
C
C   DATA-BASE NAME AND MIDAS INDEX POINTER ARRAY
       INTEGER TPNAM(16)       /* TAPE DATA FILE NAME
       INTEGER TPLEN           /* NAME LENGTH
       INTEGER TCHN            /* CHAN. TO DATA BASE FILE
       INTEGER TPARR(14)       /* MIDAS INFO ARRAY
       INTEGER TPERR           /* MIDAS ERROR CODE
       INTEGER TFCNT           /* TAPE FILE COUNT (PRESENT)
C                              /*  TFCNT = 1 FOR 1st FILE.
C
       EQUIVALENCE (TPARR,TPERR)
       COMMON /TCOM/ TREC,TPNAM,TPLEN,TCHN,TPARR,TFCNT
```

```
C AI: AUTOMATED INSPECTION - TOP LEVEL
C
C     ****************************************************************
C     *                                                              *
C     *           REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C     *           VERSION 1.0     JUNE 1,1980                        *
C     *           BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C     *                                                              *
C     ****************************************************************
C
C     *THIS IS THE MAIN PROGRAM FOR THE AUTOMATED INSPECTION SYSTEM   *
C     *FUNCTION:  1. OPEN DATA BASE FILES                             *
C     *           2. INITIATE, INSPECTION, PLANNING, OR RETRIEVAL     *
C     *           3. OR CLOSE DATA BASE FILES AND EXIT                *
C
$INSERT PCOM
$INSERT PTCOM
$INSERT RCOM
$INSERT RTCOM
$INSERT TCOM
$INSERT SYSCOM>CRTCTRL
C
       COMMON/OREZ/ZERO(8191)
C
       LOGICAL EQUIP
C
       EQUIP = .FALSE.
C
C SET UP TERMINAL CODES, OPEN DATA BASE FILES
C----------
       CALL INITAL(IERR)
       IF (IERR .NE. 0) CALL EXIT
C
C GET FUNCTION: INSPECT,PLAN,RETREIVE HISTORY,CLOSE FILES
C----------
10     CALL GFUNCT(MENU)
       IF (MENU .EQ. 0) GOTO 950
       GOTO (20,30,40), MENU
       GOTO 950
C
C PERFORM INSPECTION
C----------
20     CALL INSP(EQUIP,IERR)
       IF (IERR) 950,10,950
C
C PLAN
C----------
30     CALL PLAN(IERR)
       IF (IERR) 950,10,950
C
C RETRIEVE HISTORY
C----------
40     CALL RETR(EQUIP,IERR)
       IF (IERR) 950,10,950
C
C CLOSE DATA BASE FILES
C----------
950    CALL CLOALL
C
C EXIT
C----------
1000   CALL EXIT
       END
```

C APDAT: APPEND DATE TO KEYWORD

```
C APDAT: APPEND DATE TO KEYWORD
C
C     ****************************************************************
C     *                                                              *
C     *           REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C     *           VERSION 1.0     JUNE 1,1980                        *
C     *           BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C     *                                                              *
C     ****************************************************************
C
C     *GENERAL PURPOSE SUBROUTINE TO APPEND DATE AND TIME TO A STRING *
C     *DATE/TIME IS FORM: MMDDYYHHMMSS                                *
C
      SUBROUTINE APDAT(KEY,LEN)
C
$INSERT SYSCOM>A$KEYS
C
      REAL*8 DD,DT,DUMMY(2)
      DIMENSION IDT(8)
      INTEGER BIAS,BI
      EQUIVALENCE (IDT,DD)
      EQUIVALENCE (IDT(5),DT)
C
      DD = DATE$A(DUMMY)      /*GET DATE
      TI = TIME$A(DT)         /*GET TIME
      CALL RMNAB(IDT,16)      /* REMOVE NON-ALPHABETICAL CHARACTERS
      IE = LEN
      IS = IE - 11
      IF (IS .LE. 0) RETURN
      CALL MSUB$A(IDT,12,1,12,KEY,LEN,IS,IE) /* APPEND THE DATE
      RETURN
      END
```

C CLOALL: CLOSE ALL OPEN CHANNELS

```
C   CLOALL: CLOSE ALL OPEN CHANNELS
C
C     ****************************************************************
C     *                                                              *
C     *           REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C     *           VERSION 1.0     JUNE 1,1980                        *
C     *           BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C     *                                                              *
C     ****************************************************************
      SUBROUTINE CLOALL
$INSERT SYSCOM>A$KEYS

      DO 100 ICH=1,62
         IF (.NOT. UNIT$A(ICH)) GOTO 100
         IF (.NOT. CLOS$A(ICH)) GOTO 100
100   CONTINUE
      RETURN
      END
```

```
C     CNEWC: CREATE NEW IMAGE PROCESSOR CO PAGE 0001


C     CNEWC: CREATE NEW IMAGE PROCESSOR COMMAND
C
C    ******************************************************************
C    *                                                                *
C    *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM          *
C    *          VERSION 1.0     JUNE 1,1980                           *
C    *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY         *
C    *                                                                *
C    ******************************************************************
C
C    *CALLED FROM: PLAN                                               *
C    *          1. INSERT COMMAND FILE  IN DATA BASE                  *
C
       SUBROUTINE CNEWC(IER)

$INSERT CCOM
$INSERT SYSCOM>PARM.K
$INSERT SYSCOM>A$KEYS
C
       INTEGER TMPR(CSZW),NAME(16)
C
       DATA NAME /'DEMO.SCREEN.FT                    '/
C
       CALL TONL
C
C   Open a channel to the screen template file
C-----------------------------------------
       CALL VOPEN$(NAME,32,1,IFCH,IER)      /* OPEN FOR READ
       IF (IER .NE. 0) GOTO 9200
C
       IS = 318
       IE = 330
       NEWSCR = 2      /* DO NOT ERASE THE SCREEN TO START
C
C  Clear record buffer
C--------------------
10     CALL ZFIL(TMPR,CSZB,0)
C
C
20     CALL PEDIT(IFCH,TMPR,IS,IE,NEWSCR)
       CALL ZMVD(TMPR,CREC,CSZB)
C
C  Check to see if record already exists.
C--------------------------------------
       IFLAG = FL$RET
       CALL NEXT$(CCHN,CREC,CNAM,CARR,IFLAG,$200,0,0,0,0)
       CALL TONL
       CALL TNOU ('COMMAND ALREADY EXISTS',24)
       CALL TONL
       GO TO 300
C
C  Store the record
C-----------------
200    CALL ADD1$(CCHN,CREC,CNAM,CARR,IFLAG,$9000,0,0,0,0)
C
C   MORE?
C--------
       IER = 0
300    IF (YSNO$A('More',4,A$DNO)) GOTO 20
C
C   CLOSE THE SCREEN CHANNEL NO.
C----------------------------
400    CALL CLOS$A(IFCH)
       RETURN
C
9000   IER = CERR
       WRITE (1,9001) CERR,CNNAM
9001   FORMAT('MIDAS ERROR =',I3,' KEY = ',15A2)
       GOTO 400
C
C
9200   WRITE (1,9201) IER,NAME
9201   FORMAT('ERROR ',I3,',  OPENING FILE ',16A2)
       RETURN
```

```
C     CNEWC: CREATE NEW IMAGE PROCESSOR CO PAGE 0002

       END
C
```

```
C     CNEWP:  CREATE NEW PLAN ENTRY
C
C     ****************************************************************
C     *                                                              *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C     *          VERSION 1.0     JUNE 1,1980                         *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C     *                                                              *
C     ****************************************************************
C
C     *CALLED BY: PLAN                                                *
C     *FUNCTION: 1. GET PART#,INSP NAME,TEST NAMES FROM OPERATOR       *
C     *          2. CREATE PLAN KEYWORD                                *
C     *          3. STORE PLAN IN DATA BASE                            *
C
        SUBROUTINE CNEWP(IER)

$INSERT PCOM
$INSERT SYSCOM>PARM.K
$INSERT SYSCOM>A$KEYS
C

        INTEGER TMPR(PSZW),NAME(16)
        INTEGER KEYO(15)           /* PRIMARY KEY
C
        DATA NAME /'DEMO.SCREEN.FT                      '/
C
        CALL TONL
C
C    Open a channel to the screen template file
C-----------------------------------------------
        CALL VOPEN$(NAME,32,1,IFCH,IER)       /* OPEN FOR READ
        IF (IER .NE. 0) GOTO 9200
C
        IS = 50
        IE = 66
        NEWSCR = 2        /* DO NOT ERASE THE SCREEN TO START
C
C   Clear record buffer
C--------------------
10      CALL ZFIL(TMPR,PSZB,0)
C
C
20      CALL FEDIT(IFCH,TMPR,IS,IE,NEWSCR)
        CALL ZMVD(TMPR,PREC,PSZB)
C
C
C   Check for internal consistancy
C-------------------------------
        IF (PNT .LE. 10) GOTO 27
        WRITE (1,26)
26      FORMAT(/,'10 IS MAXIMUM NUMBER OF TESTS!',/)
        GOTO 20
C
27      IF (TMPR(11) .NE. 0) GOTO 28
        WRITE(1,31)
31      FORMAT(1X,'INSPECTION NAME MANDATORY!')
        GOTO 20
C
28      DO 30 I=1,PNT
           IBIAS = 22 + (I-1)*PNWT
           IF (TMPR(IBIAS) .NE. 0) GOTO 30
           WRITE (1,29)
29         FORMAT(/,'NUMBER OF TESTS NOT CONSISTENT!',/)
           GOTO 20
30      CONTINUE
C
C   Create a primary keyword.
C-------------------------
        CALL CRPKEY(PPN,20,PIN,20,0,0,0,0,KEYO,30)
C
        LEN = LSIZE(KEYO,30)
C
C   Check to see if record already exists.
C------------------------------------------
```

```
      IFLAG = FL$RET
      CALL NEXT$(PCHN,PREC,KEYO,PLARR,IFLAG,$200,0,0,0,0)
      CALL TONL
      CALL TNOU ('PLAN NUMBER ALREADY EXISTS',26)
      CALL TONL
      GO TO 300
C
C
C
C  Store the record
C------------------
200   CALL ADD1$(PCHN,PREC,KEYO,PLARR,IFLAG,$9000,0,0,0,0)
C
C  Insert the secondary keys
C--------------------------
      IBIAS = 22
      IFLAG = FL$USE
C
      DO 220 I=1,PNT
        CALL ADD1$(PCHN,KEYO,PREC(IBIAS),PLARR,IFLAG,$9100,1,0,0,0)
        IBIAS = IBIAS + PNWT
220   CONTINUE
C
C   MORE?
C--------
300   IF (YSNO$A('More',4,A$DNO)) GOTO 20
C
C   CLOSE THE SCREEN CHANNEL NO.
C-----------------------------
400   CALL CLOS$A(IFCH)
      RETURN
C
9000  IER = PLERR
      WRITE (1,9001) PLERR,KEYO
9001  FORMAT('MIDAS ERROR =',I3,' KEY = ',15A2)
      GOTO 400
C
9100  IER = PLERR
      JBIAS = IBIAS + PNWT - 1
      WRITE (1,9101) PLERR,(PREC(I),I=IBIAS,JBIAS)
9101  FORMAT('MIDAS ERROR =',I3,' KEY = ',15A2)
      GOTO 400
C
C
9200  WRITE (1,9201) IER,NAME
9201  FORMAT('ERROR ',I3,',  OPENING FILE ',16A2)
      RETURN
C
C
9900  FORMAT('ERROR = ',I3)
      END
C
```

```
C     CNEWT:  CREATE NEW TEST ENTRY
C
C     ****************************************************************
C     *                                                              *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C     *          VERSION 1.0     JUNE 1,1980                         *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C     *                                                              *
C     ****************************************************************
C
C     *CALLED FROM: PLAN                                             *
C     *FUNCTION: 1. GET TEST NAME, DESCRIPTION, MOTOR POSITIONS,     *
C     *             AND IMAGE PROCESSES FORM PLANNER                 *
C     *          2. INSERT TEST IN DATA BASE                         *
C
        SUBROUTINE CNEWT(IER)

$INSERT PTCOM
$INSERT SYSCOM>PARM.K
$INSERT SYSCOM>A$KEYS
C

        INTEGER TMPR(PTSZW),NAME(16)
        INTEGER KEYO(10)          /* PRIMARY KEY
C
        DATA NAME /'DEMO.SCREEN.FT                  '/
C
        CALL TONL
C
C   Open a channel to the screen template file
C-------------------------------------------
        CALL VOPEN$(NAME,32,1,IFCH,IER)      /* OPEN FOR READ
        IF (IER .NE. 0) GOTO 9200
C
        IS = 75
        IE = 98
        NEWSCR = 2      /* DO NOT ERASE THE SCREEN TO START
C
C  Clear record buffer
C--------------------
10      CALL ZFIL(TMPR,PTSZB,0)
C
C
20      CALL PEDIT(IFCH,TMPR,IS,IE,NEWSCR)
        CALL ZMVD(TMPR,PTREC,PTSZB)
C       WRITE(1,1098)PTNM    /* ***CHECKOUT***
1098    FORMAT(1X,'PTNM FROM CNEWT=',10A2)
C
C  Check to see if record already exists.
C------------------------------------
        IFLAG = FL$RET
        CALL NEXT$(PTCHN,PTREC,PTNM,PTARR,IFLAG,$200,0,0,0,0)
        CALL TONL
        CALL TNOU ('PLAN TEST ALREADY EXISTS',24)
        CALL TONL
        GO TO 300
C
C  Store the record
C----------------
200     CALL ADD1$(PTCHN,PTREC,PTNM,PTARR,IFLAG,$9000,0,0,0,0)
C       CALL TDUMP(PTREC,PTSZB)
C
C   MORE?
C-------
        IER = 0
300     IF (YSNO$A('More',4,A$DNO)) GOTO 20
C
C   CLOSE THE SCREEN CHANNEL NO.
C----------------------------
400     CALL CLOS$A(IFCH)
        RETURN
C
9000    IER = PTERR
        WRITE (1,9001) PTERR,PTNM
9001    FORMAT('MIDAS ERROR =',I3,' KEY = ',15A2)
```

```
      GOTO 400
C
C
9200  WRITE (1,9201) IER,NAME
9201  FORMAT('ERROR ',I3,',  OPENING FILE ',16A2)
      RETURN
C
C
9900  FORMAT('ERROR = ',I3)
      END
C
```



```
C CRPKEY: CREATE PLAN KEYWORD
C
C     ***********************************************************
C     *                                                         *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM   *
C     *          VERSION 1.0    JUNE 1,1980                     *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY  *
C     *                                                         *
C     ***********************************************************
C
C     *GENERAL PURPOSE SUBROUTINE TO CREATE A KEYWORD           *
C     *FUNCTION: 1. CONCATENATE TEXT STRINGS WITH A '/' INBETWEEN *
C     *          2. APPENDS DATE AND TIME TO END                *
C
        SUBROUTINE CRPKEY(TEXT1,MAX1,TEXT2,MAX2,TEXT3,MAX3,TEXT4,MAX4,
     C   KEY,MAXKEY)
C
$INSERT SYSCOM>A$KEYS
C
        CALL ZFIL(KEY,MAXKEY,'  ')
        LEN1 =  LSIZE(TEXT1,MAX1)       /*FIND LENGTH OF FIRST STRING
        CALL ZMV(TEXT1,LEN1,KEY,MAXKEY) /*MOVE FIRST STRING INTO KEY
        IF (TEXT2 .EQ. 0) GOTO 1000
        IPOS = LEN1 + 1
        CALL MCHR$A(KEY,IPOS,'/ ',1)    /*INSERT "/" INTO KEY
        IPOS = IPOS + 1
        LEN2 = LSIZE(TEXT2,MAX2)        /*FIND LENGTH OF SECOND STRING
        CALL MSUB$A(TEXT2,MAX2,1,LEN2,KEY,MAXKEY,IPOS,MAXKEY)
        IF (MAX3 .LE. 0) GOTO 1000
        IF (TEXT3 .EQ. 0) GOTO 1000
 C
        IPOS = LSIZE(KEY,MAXKEY) + 1
        CALL MCHR$A(KEY,IPOS,'/ ',1)      /*INSERT "/" INTO KEY
        IPOS = IPOS + 1
        CALL MSUB$A(TEXT3,MAX3,1,MAX3,KEY,MAXKEY,IPOS,MAXKEY)
        IF (MAX4 .LE. 0) GOTO 1000
 C
        IPOS = LSIZE(KEY,MAXKEY) + 1
        IF (TEXT4 .EQ. 0) GOTO 1000
        CALL MCHR$A(KEY,IPOS,'/',1)     /*INSERT "/" INTO KEY
        IPOS = IPOS + 1
        CALL MSUB$A(TEXT4,MAX4,1,MAX4,KEY,MAXKEY,IPOS,MAXKEY)
 1000   RETURN
        END
```

```
C CRRES: CREATE RESULTS RECORD
C
C     ***********************************************************
C     *                                                         *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM   *
C     *          VERSION 1.0    JUNE 1,1980                     *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY  *
C     *                                                         *
C     ***********************************************************
C
C     *CALLED BY: DINSP                                         *
C     *FUNCTION:  1. CREATE TEST RESULT NAMES (CRPKEY)          *
C     *           2. FILL MAIN RESULT RECORD FROM PLAN (ZMVD)   *
C
       SUBROUTINE CRRES(SERIAL,IID,IERR)
C
$INSERT PCOM
$INSERT PTCOM
$INSERT RCOM
$INSERT SYSCOM>PARM.K
C
       INTEGER BIAS,BI,IBUF(10),IKEY(RNWT),BIAS2,BI2,TBIAS
C
       NSIZ = RNWT*2
C
       TBIAS = 22              /* TEST NAME BIAS
C
       DO 10 I = 1,PNT         /*CREATE TESTNAMES FOR RCOM
          CALL NEXT$(PTCHN,PTREC,PREC(TBIAS),PTARR,FL$RET,$9000,0,0,0,0)
          TBIAS = TBIAS + PNWT
          BIAS = 2*(22 + (I-1)*PNWT)  - 1
          BIAS2 = BIAS  + 2*PNWT - 1
          BI = 2*(43 + (I-1)*RNWT) - 1
          BI2 = BI + 2*RNWT - 1
C
C PUT PREC(BIAS) INTO IBUF
C
          CALL MSUB$A(PREC,PSZB,BIAS,BIAS2,IBUF,20,1,20)
C
C CREATE KEY INTO IKEY
C
          CALL CRPKEY(PPN,20,PIN,20,SERIAL,20,IBUF,20,IKEY,NSIZ)
          CALL APDAT(IKEY,NSIZ)
C
C MOVE IKEY INTO RREC(BI)
C
          CALL MSUB$A(IKEY,NSIZ,1,NSIZ,RREC,RSZB,BI,BI2)
10     CONTINUE
C
       CALL ZMVD(PPN,RPN,20)
       CALL ZMVD(PIN,RIN,20)
       CALL ZMVD(IID,RIID,10)
       CALL ZMVD(SERIAL,RSNO,20)
       RETURN
C
9000   IERR = PTERR
       WRITE(1,9010)IERR,TBIAS
9010   FORMAT(1X,'ERROR ',I2,' BIAS = ',I3,' IN CRRES CHECK PLANTEST')
       RETURN
       END
```

```
C  CRTRES: CREATE A TEST RESULTS RECORD.
C
C     ***************************************************************
C     *                                                             *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C     *          VERSION 1.0     JUNE 1,1980                        *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C     *                                                             *
C     ***************************************************************
C
C     *CALLED BY: DINSP                                             *
C     *FUNCTION: 1. MOVE TEST PLAN RECORD TO TEST RESULTS RECORD    *
C     *          2. MOVE IMAGE NAME TO TEST RESULTS RECORD          *
C     *          3. MOVE TAPE NAME TO TEST RESULTS RECORD           *
C
      SUBROUTINE CRTRES(I,RTKEY)
C
C  I = TEST SEQUENCE NO.
C
$INSERT PTCOM
$INSERT RCOM
$INSERT RTCOM
$INSERT TCOM
C
      IBIAS = 43 + (I-1)*RNWT
      IMGSIZ = TNWT*2
C
C  ZERO THE RECORD
C
      CALL ZFIL(RTREC,RTSZB,0)
C
C  MOVE A COPY OF TEST PLAN TO RESULTS RECORD
C
      CALL ZMVD(PTREC,RTREC,PTSZB)
C
C  STORE THE IMAGE NAME
C
      CALL ZMVD(RREC(IBIAS),RTIMN,IMGSIZ)
      CALL ZMVD(RTIMN,RTKEY,IMGSIZ)
C
C  PLUS THE TAPE NAME & NUMBER
C
      CALL ZMVD(TNAM,RTTNM,20)
      RTFNM = TFCNT
C
      RETURN
      END
```

```
C DBPRM: INSERT DATA BASE PARAMETERS
C
C     ****************************************************************
C     *                                                              *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C     *          VERSION 1.0     JUNE 1,1980                         *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C     *                                                              *
C     ****************************************************************
C
C     * CALLED BY: INITAL                                            *
C     * FUNCTION: LOAD DATA BASE NAMES, NAMELENGTHS INTO COMMON FILES *
C
        SUBROUTINE DBPRM
C
$INSERT FCOM
$INSERT PTCOM
$INSERT RCOM
$INSERT RTCOM
$INSERT TCOM
$INSERT CCOM
C
C   INSERT NAMES
        PLLEN = 8
        CALL ZMV('PLAN.DB                          ',PLLEN,PLNAM,32)
        PTLEN = 11
        CALL ZMV('PLNTEST.DB                       ',PTLEN,PTNAM,32)
        RLLEN = 10
        CALL ZMV('INSRES.DB                        ',RLLEN,RLNAM,32)
        RTLEN = 12
        CALL ZMV('INSTESTR.DB                      ',RTLEN,RTNAM,32)
        TPLEN = 8
        CALL ZMV('TAPE.DB                          ',TPLEN,TPNAM,32)
        CLEN = 11
        CALL ZMV('COMMAND.DB                       ',CLEN,CNNAM,32)
        RETURN
        END
```

```
C DINSP: DO THE INSPECTION
C
C     ***********************************************************
C     *                                                         *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM   *
C     *          VERSION 1.0    JUNE 1,1980                      *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY   *
C     *                                                         *
C     ***********************************************************
C
C     *CALLED BY: INSP                                          *
C     *FUNCTION: 1. INITIALIZE IMAGE PROCESSOR, IF REQUIRED (INTIP)   *
C     *          2. INITIALIZE MOTORS, IF REQUIRED (INTMOT)     *
C     *          3. INITIALIZE MAG TAPE, IF REQUIRED (INTAP)    *
C     *          4. CREATE A MAIN RESULT RECORD (CRRES)         *
C     *          5. DO THE FOLLOWING FOR EACH TEST:             *
C     *             A. GET TEST PLAN (GPTST)                    *
C     *             B. CREATE TEST RESULT RECORD (CRTRES)       *
C     *             C. POSITION MOTORS (PMOT)                   *
C     *             D. PROCESS THE IMAGE (PIMG)                 *
C     *             E. SAVE THE TEST RESULTS (SVRES)            *
C     *          6. SAVE THE MAIN TEST RESULTS (SVMRES)         *
C
      SUBROUTINE DINSP(IID,SERIAL,EQUIP,DEFALT,IERR)
C
$INSERT PCOM
$INSERT RCOM
C
      LOGICAL EQUIP
      INTEGER RTKEY(RNWT)
C
      IF (EQUIP) GOTO 10
C INITIALIZE IMAGE PROCESSOR
C----------
      CALL INTIP(IERR)
      IF (IERR .NE. 0) RETURN
C INITIALIZE MOTORS
C----------
      CALL INTMOT(IERR)
      IF (IERR .NE. 0) RETURN
C INITIALIZE TAPE
C----------
10    CALL INTAP(EQUIP,NOTAPE,IERR)
      IF (IERR .NE. 0) RETURN
      EQUIP = .TRUE.
C SET OVERALL PASS-FAIL CODE TO ZERO
C----------
      RPF = 0
C CREATE THE RESUTLTS MAIN RECORD
C----------
20    CALL CRRES(SERIAL,IID,IERR)
      IF (IERR .NE. 0) RETURN
C
C DO FOR EACH TEST
C
      DO 30 I = 1,PNT
C GET PLAN'S TEST
C----------
21      CALL GPTST(I,IERR)
        IF  (IERR .NE. 0) RETURN
C  LOAD RTCOM
C----------
      CALL CRTRES(I,RTKEY)
C POSITION MOTORS
C----------
        CALL PMOT
C PERFORM IMAGE PROCESSING PER TEST
C----------
        CALL PIMG(I,NOTAPE,IERR)
C SAVE THE INSPECTION TEST RESULTS
C----------
        CALL SVRES(DEFALT,NOTAPE,I,RTKEY,IERR)
        IF (IERR .NE. 0) RETURN
30    CONTINUE
C
```

```
C SAVE THE RESULTS MAIN RECORD
C-----------
      CALL SVMRES(IER)
      RETURN
      END
```

```
C DLTC: DELETE IMAGE PROCESSOR COMMAND
C
C     ***************************************************************
C     *                                                             *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C     *          VERSION 1.0     JUNE 1,1980                        *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C     *                                                             *
C     ***************************************************************
C
C     *CALLED BY: PLAN                                              *
C     *FUNCTION: 1. GET COMMAND NAME FROM OPERATOR                  *
C     *          2. FIND RECORD IN COMMAND DATA BASE                *
C     *          3. DELETE THE COMMAND RECORD                       *
C
C ARG 1: IERR       INTEGER
C
      SUBROUTINE DLTC(IERR)
C
$INSERT CCOM
$INSERT SYSCOM>PARM.K
C
      INTEGER CNAME(10)
      LOGICAL MORE
C
C GET TEST NAME
C
10    WRITE(1,20)
20    FORMAT(1X,'COMMAND NAME?')
      READ(1,25,ERR = 10) CNAME
25    FORMAT(10A2)
C
C FIND THE RECORD
C
      IFLAG = FL$RET
      CALL NEXT$(CCHN,CREC,CNAME,CARR,IFLAG,$8000,0,0,0,0)
C
C DELETE THE RECORD
C
      IFLAG = FL$RET + FL$USE
      CALL DELET$(CCHN,CREC,CNAME,CARR,IFLAG,$9000,0,0,0,0)
      WRITE(1,30)CNAME
30    FORMAT(1X,10A2,' DELETED')
      CALL DMORE(MORE)
      IF (MORE) GOTO 10
      RETURN
C
8000  IF (CERR .NE. 7) GOTO 8005
      WRITE(1,8004) CNAME
8004  FORMAT(10A2,' COMMAND NOT FOUND')
      RETURN
C
8005  WRITE(1,8010)IERR,CNAME
8010  FORMAT(1X,'MIDAS ERROR ',I3,' IN FINDING ',10A2)
      RETURN
C
9000  IERR = CERR
      WRITE(1,9010)IERR,CNAME
9010  FORMAT(1X,'MIDAS ERROR ',I2,' IN DELETING ',10A2)
      RETURN
      END
```

```
C DLTP: DELETE A PLAN
C
C    ****************************************************************
C    *                                                              *
C    *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C    *          VERSION 1.0     JUNE 1,1980                         *
C    *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C    *                                                              *
C    ****************************************************************
C
C    *CALLED BY: PLAN
C    *FUNCTION: 1. GET PART#,INSPECTION NAME FROM OPERATOR           *
C    *          2. CREATE THE PLAN KEYWORD                           *
C    *          3. GET THE RECORD FROM DATA BASE                     *
C    *          4. DELETE SECONDARY AND PRIMARY KEYWORDS AND RECORD  *
C
C ARG 1: IERR   INTEGER
C
      SUBROUTINE DLTP(IERR)
$INSERT PCOM
$INSERT SYSCOM>PARM.K
$INSERT SYSCOM>A$KEYS
$INSERT SYSCOM>KEYS.F
C
      INTEGER IBUF(20),DPART(10),DIIN(10),DKEY(20),BIAS,PTEMP(PSZW)
      LOGICAL ZCM
C
      EQUIVALENCE (IBUF,DPART)
      EQUIVALENCE (IBUF(11),DIIN)
C
      CALL ZFIL(IBUF,40,0)     /* ZERO THE PEDIT BUFFER
      CALL VOPEN$('DEMO.SCREEN.FT',14,1,ICH,IERR) /* OPEN PEDIT CHANNEL
      IF (IERR .NE. 0) GOTO 9000
C
C SET UP PEDIT PARAMETERS
C
      IERR = 0
      IS = 51
      IE = 52
      NEWSCR = 2
C
C GET PART # AND INSPECTION NAME FROM PEDIT
C
      CALL PEDIT(ICH,IBUF,IS,IE,NEWSCR)
C
C CLOSE PEDIT RECORD
C
      CALL CLOS$A(ICH)
C
C MAKE IBUF INTO KEY
C
      CALL CRPKEY(DPART,20,DIIN,20,0,0,0,0,DKEY,40)
C
C GET THE RECORD
C
      CALL NEXT$(PCHN,PREC,DKEY,PLARR,FL$RET,$9050,0,0,0,0)
C
      BIAS = 22
C
10    IF (PREC(BIAS) .EQ. 0) GOTO 20
C
C DELETE SECONDARY KEYS
C
C    FIND SECONDARY KEYS
C
      IFLAG = FL$RET
30    CALL NEXT$(PCHN,PTEMP,PREC(BIAS),PLARR,IFLAG,$20,1,0,0,0)
C
C    COMPARE PREC AND PTEMP
C
      IFLAG = FL$RET + FL$USE
      ISIZE = PSZB
      IF (.NOT. ZCM(PTEMP,ISIZE,PREC,ISIZE,ICODE)) GOTO 30
C
C    DELETE THE SECONDARY KEY
```

```
C
      CALL DELET$(PCHN,PREC,PREC(BIAS),PLARR,IFLAG,$20,1,0,0,0)
C
      BIAS = BIAS + PNWT
      GOTO 10
C
C DELETE PRIMARY KEY AND RECORD
C
20    IFLAG = FL$RET
      CALL DELET$(PCHN,PREC,DKEY,PLARR,IFLAG,$9100,0,0,0,0)
      WRITE(1,80)DKEY
80    FORMAT(1X,'DELETED ',20A2)
      RETURN
9000  WRITE(1,9010)IERR
9010  FORMAT(1X,'ERROR ',I2,' IN OPENING DEMO.SCREEN.FT')
      RETURN
C
9050  IF (PLERR .NE. 7) GOTO 9065
      WRITE(1,9060)
9060  FORMAT(1X,'RECORD NOT FOUND')
      RETURN
9065  WRITE(1,9070)PLERR,PREC(BIAS)
9070  FORMAT(1X,'MIDAS ERROR ',I2,' IN FINDING KEY ',20A2)
      IERR = PLERR
      RETURN
C
9100  WRITE(1,9110) PLERR,DKEY
9110  FORMAT(1X,'MIDAS ERROR ',I2,' IN DELETING ',20A2)
      IERR = PLERR
      RETURN
      END
```



```
C DLTR: DELETE RESULTS
C
C    ***************************************************************
C    *                                                             *
C    *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C    *          VERSION 1.0    JUNE 1,1980                         *
C    *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C    *                                                             *
C    ***************************************************************
C
C    *CALLED FROM: PLAN                                            *
C    *FUNCTION: 1. GET PART#,INSPECTION NAME FROM OPERATOR         *
C    *          2. FIND A MATCH IN DATA BASE                       *
C    *          3. IF CORRECT RESULT, DELETE IT AND THE RESULT TESTS *
C
      SUBROUTINE DLTR(IER)
C
      WRITE (1,1)
1     FORMAT('** DELETE RESULTS IS A FORBIDDEN TRANSACTION **')
      IER = 0
      RETURN
      END
```

```
C DLTT: DELETE TEST PLAN
C
C     ***********************************************************
C     *                                                         *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM   *
C     *          VERSION 1.0     JUNE 1,1980                    *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY  *
C     *                                                         *
C     ***********************************************************
C
C     *CALLED BY: PLAN                                            *
C     *FUNCTION: 1. GET TEST NAME FROM OPERATOR                   *
C     *          2. FIND RECORD IN TEST DATA BASE                 *
C     *          3. DELETE THE TEST RECORD                        *
C
C ARG 1: IERR       INTEGER
C
      SUBROUTINE DLTT(IERR)
C
$INSERT PTCOM
$INSERT SYSCOM>PARM.K
C
      INTEGER PTNAME(10)
      LOGICAL MORE
C
C GET TEST NAME
C
10    WRITE(1,20)
20    FORMAT(1X,'TEST NAME?')
      READ(1,25,ERR = 10) PTNAME
25    FORMAT(10A2)
C
C FIND THE RECORD
C
      IFLAG = FL$RET
      CALL NEXT$(PTCHN,PTREC,PTNAME,PTARR,IFLAG,$8000,0,0,0,0)
C
C DELETE THE RECORD
C
      IFLAG = FL$RET + FL$USE
      CALL DELET$(PTCHN,PTREC,PTNAME,PTARR,IFLAG,$9000,0,0,0,0)
      WRITE(1,30)PTNAME
30    FORMAT(1X,10A2,' DELETED')
      CALL DMORE(MORE)
      IF (MORE) GOTO 10
      RETURN
C
8000  IF (PTERR .NE. 7) GOTO 8005
      WRITE(1,8004) PTNAME
8004  FORMAT(10A2,' TEST PROCEDURE NOT FOUND')
      RETURN
C
8005  WRITE(1,8010)IERR,PTNAME
8010  FORMAT(1X,'MIDAS ERROR ',I3,' IN FINDING ',10A2)
      RETURN
C
9000  IERR = PTERR
      WRITE(1,9010)IERR,PTNAME
9010  FORMAT(1X,'MIDAS ERROR ',I2,' IN DELETING ',10A2)
      RETURN
      END
```

```
C DMORE:  DO YOU WANT TO DO MORE?
C
C     ******************************************************************
C     *                                                                *
C     *           REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM         *
C     *           VERSION 1.0     JUNE 1,1980                          *
C     *           BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY        *
C     *                                                                *
C     ******************************************************************
C
C     *GENERAL PURPOSE SUBROUTINE TO SEE IF OPERATOR NEEDS TO DO       *
C     * A FUNCTION AGAIN                                               *
C
      SUBROUTINE DMORE(MORE)
C
$INSERT SYSCOM>A$KEYS
C
      LOGICAL MORE,YSNO$A
C
      MORE = YSNO$A('More',4,A$DNO)
      RETURN
      END
```

```
C DSPLD: DISPLAY OR PRINT PLAN OR RESULT DATA.
C
C    ****************************************************************
C    *                                                              *
C    *           REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C    *           VERSION 1.0     JUNE 1,1980                        *
C    *           BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C    *                                                              *
C    ****************************************************************
C
C    *CALLED FROM: PLAN                                              *
C    *FUNCTION: 1. GET DISPLAY FUNCTION FROM OPERATOR (GDFNCT)       *
C    *          2. CALL ONE OF FOLLOWING SUBROUTINES                 *
C    *             DSPP   - DISPLAY A PLAN                           *
C    *             DSPPT  - DISPLAY A TEST                           *
C    *             DSPR   - DISPLAY MAIN RESULTS                     *
C    *             DSPRT  - DISPLAY TEST RESULTS                     *
C    *             DSPT   - DISPLAY TAPE RECORD                      *
C    *             LISTIX- LIST RECORD BY INDEX NO.                  *
C    *          3. IF MAILSTOP GIVEN,SPOOL INFO TO LINE PRINTER      *
C
C ARG 1: IERR        INTEGER
C
      SUBROUTINE DSPLD(IERR)
C
      INTEGER SPFNAM(7),SPCHN
C
C
C GET DISPLAY FUNCTION
C
10    CALL GDFNCT(MENU,SPCHN,SPFNAM)
C
      IF (MENU .EQ. 0) RETURN
      GOTO (100,200,300,400,500,600,700,800), MENU
C
C DISPLAY MAIN PLAN
C
100   CALL DSPP(SPCHN)
      GOTO 8000
C
C DISPLAY PLAN TEST
C
200   CALL DSPPT(SPCHN)
      GOTO 8000
C
C DISPLAY MAIN RESULTS
C
300   CALL DSPR(SPCHN)
      GOTO 8000
C
C DISPLAY TEST RESULTS
C
400   CALL DSPRT(SPCHN)
      GOTO 8000
C
C DISPLAY TAPE RECORD
C
500   CALL DSPT(SPCHN)
      GOTO 8000
C
C LIST INDEX
C
600   CALL LISTIX(SPCHN)
      GOTO 8000
C
C SOME OTHER FUNCTION
C
700   GOTO 8000
C
C SOME OTHER FUNCTION
C
800   GOTO 8000
C
C PRINT RESULTS?
C
```

```
8000    IF (SPCHN .EQ. 0) GOTO 10
        CALL SPOLIT(SPCHN,SPFNAM)
        GOTO 10
        END
```

```
C DSPP: DISPLAY MAIN PLAN
C
C     ***************************************************************
C     *                                                             *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C     *          VERSION 1.0    JUNE 1,1980                         *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C     *                                                             *
C     ***************************************************************
C
C     *CALLED BY: DSPLD                                             *
C     *FUNCTION: 1. GET PART#,INSPECTION NAME FROM OPERATOR (PEDIT) *
C     *          2. FIND RECORD IN DATA BASE                        *
C     *          3. PRINT/DISPLAY THE RECORD                        *
C     *          4. IF OPERATOR WANTS TO SEE A TEST:                *
C     *             A. FIND THE RECORD                              *
C     *             B. DISPLAY IT                                   *
C
      SUBROUTINE DSPP(REPCHN)
C
C ARG 1: REPCHN    INTEGER, REPORT CHANNEL
C
$INSERT PCOM
$INSERT PTCOM
$INSERT SYSCOM>PARM.K
$INSERT SYSCOM>A$KEYS
C
      INTEGER REPCHN,PKEY(20)
C
C OPEN SCREEN TEMPLATE
C
      CALL VOPEN$('DEMO.SCREEN.FT',14,1,IPCHN,IER)
      IF (IER .NE. 0) GOTO 9000
C
C GET PART NUMBER, INSPECTION NAME
C
      N = -1
      IS = 49
      IE = 52
      NEWSCR = 2       /* DO NOT ERASE SCREEN TO START
      CALL ZFIL(PREC,PSZB,0)
      CALL PEDIT(IPCHN,PREC,IS,IE,NEWSCR)
C
      CALL CRPKEY(PPN,20,PIN,20,0,0,0,0,PKEY,40)      /* CREATE KEYWORD
      NCHAR = LSIZE(PKEY,40)  /* GET LENGTH OF KEYWORD
      IFLAG = FL$RET + FL$BIT
C
C FIND THE RECORD
C
10    CALL NEXT$(PCHN,PREC,PKEY,PLARR,IFLAG,$9100,0,0,0,NCHAR)
C
C PRINT/DISPLAY THE RECORD
C
      IS = 49
      IE = 64
      NEWSCR = 2
      WRITE (1,11)
11    FORMAT(/)
      CALL RPTGEN(REPCHN,IPCHN,PREC,LINES,IS,IE,NEWSCR)
20    IF (REPCHN .NE. 0) GOTO 9900
      IFLAG = FL$RET + FL$USE + FL$BIT
C
      CALL READN(
     - '-1 = QUIT, 0 = MORE MATCHES, N = SEE NTH TEST: ',47,N)
      IF (N) 9900,10,25
C
C FIND A TEST RECORD
C
25    IBIAS = 22 + (N-1)*PNWT
      IFLAG = FL$RET
30    CALL NEXT$(PTCHN,PTREC,PREC(IBIAS),PTARR,IFLAG,$9200,0,0,0,0)
C
C PRINT/DISPLAY THE TEST PLAN
C
      IS = 74
```

```
      IE = 99
      WRITE (1,11)
      CALL RPTGEN(REPCHN,IPCHN,PTREC,LINES,IS,IE,NEWSCR)
      GOTO 20
C
C ERRORS
C
9000  WRITE(1,9010)IER
9010  FORMAT(1X,'ERROR ',I3,' IN OPENING DEMO.SCREEN.FT')
      RETURN
C
9100  IF (PLERR .NE. 7) GOTO 9120
      IF (N .EQ. 0) GOTO 9900
      WRITE(1,9110)PKEY
9110  FORMAT(/,1X,20A2,' NOT FOUND')
      GOTO 9900
9120  IF (PLERR .EQ. 22 .OR. PLERR .EQ. 24) GOTO 9140
      WRITE(1,9130)PLERR,PKEY
9130  FORMAT(1X,'MIDAS ERROR ',I3,' IN FINDING ',20A2)
      GOTO 9900
9140  CALL RECYCL
      GOTO 10
C
9200  IF (PTERR .NE. 7) GOTO 9220
      CALL TNOUA(PREC(IBIAS),20)
      CALL TNOU(' NOT FOUND',10)
      GOTO 9900
9220  IF  (PTERR .EQ. 22 .OR. PTERR .EQ. 24) GOTO 9240
      WRITE(1,9230)PTERR
9230  FORMAT(1X,'MIDAS ERROR ',I3,' IN FINDING ')
      CALL TNOU(PREC(IBIAS),50)
      GOTO 9900
9240  CALL RECYCL
      GOTO 30
C
C EXIT
C
9900  CALL CLOS$A(IPCHN)
      RETURN
      END
```

```
C DSPPT: DISPLAY ONE TEST PLAN
C
C     ************************************************************
C     *                                                          *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM    *
C     *          VERSION 1.0     JUNE 1,1980                     *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY   *
C     *                                                          *
C     ************************************************************
C
C     *CALLED BY: DSPLD                                             *
C     *FUNCTION : 1. GET TEST NAME FROM OPERATOR (PEDIT)            *
C     *           2. FIND THE RECORD IN TEST DATA BASE              *
C     *           3. PRINT/DISPLAY THE RECORD                       *
C
      SUBROUTINE DSPPT(SPCHN)
C
C ARG 1: SPOOL CHANNEL  SPCHN     INTEGER
C
$INSERT PTCOM
$INSERT SYSCOM>PARM.K
$INSERT SYSCOM>A$KEYS
C
C
C OPEN SCREEN TEMPLATE
C
      CALL VOPEN$('DEMO.SCREEN.FT',14,1,IPCHN,IERR)
      IF (IERR. NE. 0) GOTO 9000
C
C  GET THE TEST NAME
C
      IS = 74
      IE = 75
      NEWSCR = 2       /* DO NOT ERASE SCREEN TO START
      CALL ZFIL(PTREC,PTSZB,0)
      CALL PEDIT(IPCHN,PTREC,IS,IE,NEWSCR)
      WRITE (1,1)
1     FORMAT(/)
C
      NCHAR = LSIZE(PTREC,20)  /* GET LENGTH OF KEYWORD
      IFLAG = FL$RET + FL$BIT
C
C  FIND THE TEST RECORD
C
10    CALL NEXT$(PTCHN,PTREC,PTREC,PTARR,IFLAG,$9100,0,0,0,NCHAR)
C
C PRINT/DISPLAY THE RECORD
C
      IS = 73
      IE = 99
      WRITE (1,11)
11    FORMAT(/)
      CALL RPTGEN(SPCHN,IPCHN,PTREC,LINES,IS,IE,2)
      IFLAG = FL$BIT + FL$RET + FL$USE
C
C ANY MORE MATCHES?
C
      J = 1
      IF (SPCHN .EQ. 0) CALL PAUS(J)
      IF (J .EQ. 0) GOTO 9900
      GOTO 10
C
C ERRORS
C
9000  WRITE(1,9010)IERR
9010  FORMAT(1X,'ERROR ',I3,' IN OPENING DEMO.SCREEN.FT')
      RETURN
C
9100  IF (PTERR .EQ. 7) GOTO 9900
      IF (PTERR .NE. 24 .AND. PTERR .NE. 22) GOTO 9150
      CALL RECYCL
      GOTO 10
C
9150  WRITE(1,9160)PTERR,PTNM
9160  FORMAT(1X,'MIDAS ERROR ',I3,' IN FINDING ',20A2)
```

```
C
9900   CALL CLOS$A(IPCHN)
       RETURN
       END
```

```
C DSPR: DISPLAY RESULTS
C
C     ****************************************************************
C     *                                                              *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C     *          VERSION 1.0    JUNE 1,1980                          *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C     *                                                              *
C     ****************************************************************
C
C     *CALLED BY: DSPLD AND RETR                                         *
C     *FUNCTION : 1. GET PART#,INSP NAME,SERIAL#,INSP ID FROM OPERATOR   *
C     *           2. CREATE THE RESULT KEYWORD                           *
C     *           3. FIND A MATCH IN DATA BASE                           *
C     *           4. PRINT/DISPLAY THE RECORD                            *
C     *           5. IF TEST RESULT DESIRED:                             *
C     *              A. FIND THE RECORD                                  *
C     *              B. DISPLAY IT                                       *
C
C ARG 1: REPCHN    INTEGER
C
      SUBROUTINE DSPR(REPCHN)
C
$INSERT RCOM
$INSERT RTCOM
$INSERT SYSCOM>PARM.K
$INSERT SYSCOM>A$KEYS
C
      INTEGER RMPRI            /* RESULTS PRIMARY KEY LENGTH WORDS
      PARAMETER RMPRI = 20
      INTEGER RKEY(RMPRI)
      INTEGER REPCHN,PN(10),IN(10),SNO(10),IID(5),IBUF(35)
      EQUIVALENCE (IBUF,IID)          /*INSPECTORS ID#
      EQUIVALENCE (IBUF(6),PN)       /*PART NUMBER
      EQUIVALENCE (IBUF(16),IN)      /*INSPECTION NAME
      EQUIVALENCE (IBUF(26),SNO)      /*SERIAL NUMBER
C
C OPEN SCREEN TEMPLATE
C
      CALL VOPEN$('DEMO.SCREEN.FT',14,1,IPCHN,IERR)
      IF (IERR .NE. 0) GOTO 9000
C
C GET PART#,INSP NAME,SERIAL#,INSP ID
C
      IS = 0
      IE = 5
      NEWSCR = 2      /* DO NOT ERASE SCREEN TO START
      CALL ZFIL(IBUF,70,0)
      CALL PEDIT(IPCHN,IBUF,IS,IE,NEWSCR)
C
      NBYTS = RMPRI*2
      CALL CRPKEY(PN,20,IN,20,SNO,20,0,0,RKEY,NBYTS)     /* CREATE KEYWORD
      NCHAR = LSIZE(RKEY,40)  /* GET LENGTH OF KEYWORD
      IFLAG = FL$RET + FL$BIT
C
C FIND A MATCH
C
10    CALL NEXT$(RLCHN,RREC,RKEY,RLARR,IFLAG,$9100,0,0,0,NCHAR)
C
C PRINT/DISPLAY THE RECORD
C
      IS = 225
      IE = 244
      NEWSCR = 2
      WRITE (1,11)
11    FORMAT(/)
      CALL RPTGEN(REPCHN,IPCHN,RREC,LINES,IS,IE,NEWSCR)
20    IF (REPCHN .NE. 0) GOTO 9900
      IFLAG = FL$RET + FL$USE + FL$BIT
C
      WRITE (1,11)
      CALL READN
     + ('-1 = QUIT, 0 = MORE MATCHES, N = SEE NTH TEST: ',47,N)
      IF (N) 9900,10,25
C
```

```
C FIND A TEST RECORD
C
25      IBIAS = 43 + (N-1)*RNWT
        IFLAG = FL$RET
30      CALL NEXT$(RTCHN,RTREC,RREC(IBIAS),RTARR,IFLAG,$9200,0,0,0,0)
C
C PRINT/DISPLAY THE TEST RESULT
C
        IS = 250
        IE = 273
        WRITE (1,11)
        CALL RPTGEN(REPCHN,IPCHN,RTREC,LINES,IS,IE,NEWSCR)
        GOTO 20
C
C ERRORS
C
9000    WRITE(1,9010)IERR
9010    FORMAT(1X,'ERROR ',I3,' IN OPENING DEMO.SCREEN.FT')
        RETURN
C
9100    IF (RLERR .NE. 7) GOTO 9120
        WRITE(1,9110)RKEY
9110    FORMAT(1X,20A2,' NOT FOUND')
        GOTO 9900
9120    IF (RLERR .EQ. 22 .OR. RLERR .EQ. 24) GOTO 9140
        WRITE(1,9130)RLERR,RKEY
9130    FORMAT(1X,'MIDAS ERROR ',I3,' IN FINDING ',20A2)
        GOTO 9900
9140    CALL RECYCL
        GOTO 10
C
9200    IF (RTERR .NE. 7) GOTO 9220
        WRITE (1,9201) (RREC(IBIAS+I),I=0,24)
9201    FORMAT(25A2,' NOT FOUND')
        GOTO 9900
9220    IF  (RTERR .EQ. 22 .OR. RTERR .EQ. 24) GOTO 9240
        WRITE(1,9230)RTERR,(RREC(IBIAS+I),I=0,24)
9230    FORMAT(1X,'MIDAS ERROR ',I3,' IN FINDING ',25A2)
        GOTO 9900
9240    CALL RECYCL
        GOTO 30
C
C EXIT
C
9900    CALL CLOS$A(IPCHN)
        RETURN
        END
```

```
C DSPRT: DISPLAY RESULTS OF ONE TEST
C
C     *************************************************************
C     *                                                           *
C     *         REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM      *
C     *         VERSION 1.0    JUNE 1,1980                        *
C     *         BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY     *
C     *                                                           *
C     *************************************************************
C
C     *CALLED BY: DSPLD AND RETR                                  *
C     *FUNCTION: 1. GET PART#,INSP NAME,SERIAL#,INSP ID FROM OPERATOR  *
C     *          2. CREATE PLAN TEST KEYWORD                      *
C     *          3. GET THE RECORD                                *
C     *          4. DISPLAY THE RECORD                            *
C
C ARG 1: SPOOL CHANNEL  SPCHN     INTEGER
C
      SUBROUTINE DSPRT(SPCHN)
C
$INSERT RTCOM
$INSERT SYSCOM>PARM.K
$INSERT SYSCOM>A$KEYS
C
      INTEGER RTPRI             /* NUMBER OF WORDS IN TEST NAME
      PARAMETER RTPRI = 20
      INTEGER RKEY(RTPRI)
      INTEGER REPCHN,PN(10),IN(10),SNO(10),IID(5),IBUF(45)
      INTEGER TN(10)
      EQUIVALENCE (IBUF,IID)          /*INSPECTORS ID#
      EQUIVALENCE (IBUF(6),PN)       /*PART NUMBER
      EQUIVALENCE (IBUF(16),IN)      /*INSPECTION NAME
      EQUIVALENCE (IBUF(26),SNO)      /*SERIAL NUMBER
      EQUIVALENCE (IBUF(36),TN)       /*TEST NAME
C
C OPEN SCREEN TEMPLATE
C
      CALL VOPEN$('DEMO.SCREEN.FT',14,1,IPCHN,IERR)
      IF (IERR. NE. 0) GOTO 9000
C
C GET PART#,INSP NAME,SERIAL#,INSP ID
C
      IS = 0
      IE = 6
      NEWSCR = 2      /* DO NOT ERASE SCREEN TO START
      CALL ZFIL(IBUF,90,0)
      CALL PEDIT(IPCHN,IBUF,IS,IE,NEWSCR)
C
      NBYT = RTPRI*2
      CALL CRPKEY(PN,20,IN,20,SNO,20,TN,20,RKEY,NBYT)  /* CREATE KEYWORD
      NCHAR = LSIZE(RKEY,40)  /* GET LENGTH OF KEYWORD
      IFLAG = FL$RET + FL$BIT
C
C  FIND THE TEST RECORD
C
10    CALL NEXT$(RTCHN,RTREC,RKEY,RTARR,IFLAG,$9100,0,0,0,NCHAR)
C
C PRINT/DISPLAY THE RECORD
C
      IS = 250
      IE = 273
      WRITE (1,11)
11    FORMAT (/)
      CALL RPTGEN(SPCHN,IPCHN,RTREC,LINES,IS,IE,2)
      IFLAG = FL$BIT + FL$RET + FL$USE
C
C ANY MORE MATCHES?
C
      CALL PAUS(J)
      IF (J .EQ. 0) GOTO 9900
      GOTO 10
C
C ERRORS
C
9000  WRITE(1,9010)IERR
```

```
9010    FORMAT(1X,'ERROR ',I3,' IN OPENING DEMO.SCREEN.FT')
        RETURN
C
9100    IF (RTERR .EQ. 7) GOTO 9900
        IF (RTERR .NE. 24 .AND. RTERR .NE. 22) GOTO 9150
        CALL RECYCL
        GOTO 10
C
9150    WRITE(1,9160)RTERR,RKEY
9160    FORMAT(1X,'MIDAS ERROR ',I3,' IN FINDING ',20A2)
C
9900    CALL CLOS$A(IPCHN)
        RETURN
        END
```

```
C DSPT: DISPLAY TAPE DATA
C
C     **************************************************************
C     *                                                            *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM      *
C     *          VERSION 1.0    JUNE 1,1980                        *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY     *
C     *                                                            *
C     **************************************************************
C
C     *CALLED BY: DSPLD AND RETR                                     *
C     *FUNCTION : 1. GET TAPE NAME OR IMAGE NAME FROM OPERATOR (PEDIT) *
C     *           2. FIND THE RECORD                                 *
C     *           3. PRINT/DISPLAY THE RECORD (RPTGEN)               *
C
C ARG 1: SPCHN  SPOOL FILE CHANNEL  INTEGER
C
      SUBROUTINE DSPT(SPCHN)
C
$INSERT TCOM
$INSERT SYSCOM>PARM.K
$INSERT SYSCOM>A$KEYS
C
      INTEGER IBUF(26),KEY(TNWT)
      LOGICAL MORE
      EQUIVALENCE (IBUF,INDEX)        /* MIDAS INDEX
      EQUIVALENCE (IBUF(2),KEY)       /* MIDAS KEYWORD
C
C OPEN SCREEN FILE
C
      CALL VOPEN$('DEMO.SCREEN.FT',14,1,ICH,IERR)
      IF (IERR .NE. 0) GOTO 9000
C
10    IS = 100
      IE = 105
      NEWSCR = 2      /*DO NOT ERASE SCREEN TO START
C
C GET INDEX AND PRIMARY OR SECONDARY KEYWORD
C PRIMARY KEY=TNAM,  SECONDARY KEYS=IMAGE NAMES
C
      CALL PEDIT(ICH,IBUF,IS,IE,NEWSCR)
C
      NBYTS = TNWT*2
      LEN = LSIZE(KEY,NBYTS)  /*FIND SIZE OF KEYWORD FOR MIDAS
C
C FIND THE RECORD
C
      IFLAG = FL$RET + FL$BIT
      INDEX = INDEX   /* ***CHECKOUT
      CALL NEXT$(TCHN,TREC,KEY,TPARR,IFLAG,$9100,INDEX,0,0,LEN)
C
C DISPLAY THE RECORD
C
      IS = 106
      IE = 160
      WRITE (1,11)
11    FORMAT(/)
      CALL RPTGEN(SPCHN,ICH,TREC,LINES,IS,IE,2)
      CALL DMORE(MORE)
      IF (MORE) GOTO 10
C
C CLOSE THE SCREEN FILE
C
100   CALL CLOS$A(ICH)
      RETURN
C
C
9000  WRITE(1,9010)IERR
9010  FORMAT(1X,'ERROR ',I3,' IN OPENING DEMO.SCREEN.FT')
      RETURN
C
9100  IF (TPERR .NE. 7) GOTO 9110
      WRITE(1,9101) KEY
9101  FORMAT('NOT FOUND: ',25A2)
      GOTO 100
```

```
9110   WRITE(1,9111)TPERR,KEY
9111   FORMAT(1X,'MIDAS ERROR ',I3,' IN FINDING ',25A2)
       GOTO 100
       END
```



```
C   FREECH: RETURNS A NUMBER OF AVAILABLE PRIMOS CHANNELS
C
C     ***************************************************************
C     *                                                             *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C     *          VERSION 1.0     JUNE 1,1980                        *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C     *                                                             *
C     ***************************************************************
C
       SUBROUTINE FREECH(NUM,ICHN)
C
C     GENERAL PURPOSE SUBROUTINE TO FIND ONE OR MORE AVAILABLE CHANNELS
C
C  NUM   = NUMBER OF FREE CHANNELS REQUESTED
C  ICHN  = AN ARRAY SIZE NUM FOR CNANNELS AVAILABLE
C
C
$INSERT SYSCOM>KEYS.F
$INSERT SYSCOM>ERRD.F
C
C
       INTEGER ICHN(1) /* DUMMY DIMENSION
       LOGICAL UNIT$A
C
       I = 1
C
       DO 100 ICH=1,63
          IF (UNIT$A(ICH)) GOTO 100
          ICHN(I) = ICH
          I = I + 1
          IF (I .GT. NUM) RETURN
100    CONTINUE
C
C   ALL UNITS IN USE: ERROR :41
       IER = E$FUIU
       RETURN

       END
```

```
C GDFNCT: GET DISPLAY FUNCTION
C
C     ****************************************************************
C     *                                                              *
C     *         REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM         *
C     *         VERSION 1.0    JUNE 1,1980                           *
C     *         BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY        *
C     *                                                              *
C     ****************************************************************
C
C     *CALLED BY: DSPLD                                              *
C     *FUNCTION: 1. GET FUNCTION FROM OPERATOR                       *
C     *          2. GET MAILSTOP FROM OPERATOR IF PRINTOUT DESIRED   *
C     *          3. IF PRINTOUT DESIRED, OPEN A SPOOL CHANNEL        *
C
C ARG 1: MENU     INTEGER
C ARG 2: SPCHN    SPOOL CHANNEL NUMBER  INTEGER
C ARG 3: SPFNAM   SPOOL FILE NAME       STRING, INTEGER ARRAY(7)
C
      SUBROUTINE GDFNCT(MENU,SPCHN,SPFNAM)
C
$INSERT SYSCOM>A$KEYS
C
      INTEGER SPCHN,SPFNAM(7)
      SPCHN = 0
C
      CALL ZFIL(SPFNAM,14,0)
C
C OPEN A CHANNEL TO SCREEN TEMPLATE
C
      CALL VOPEN$('DEMO.SCREEN.FT',14,1,ICH,IERR)
      IF (IERR .NE. 0) GOTO 9000
C
C GET MENU AND MAIL STOP FROM SCREEN
C
      IS = 175
      IE = 184
      NEWSCR = 2      /* DO NOT ERASE SCREEN TO START
10    CALL PEDIT(ICH,SPFNAM,IS,IE,NEWSCR)
      IF (SPFNAM(1) .GE. 0 .AND. SPFNAM(1) .LE. 8) GOTO 30
      WRITE(1,20)
20    FORMAT(1X,'MENU NOT IN RANGE')
      GOTO 10
C
C CLOSE THE SCREEN FILE
C
30    CALL CLOS$A(ICH)
C
      MENU = SPFNAM(1)
C
      IF (SPFNAM(5) .EQ. 0) RETURN
C
      CALL ZMVD('MAILSTOP.',SPFNAM,9)
C
      CALL PACK(SPFNAM,14)
C
C OPEN A CHANNEL TO SPOOL FILE FOR WRITING
C
      CALL VOPEN$(SPFNAM,14,2,SPCHN,IERR)
      IF (IERR .NE. 0) GOTO 9100
      RETURN
C
C ERROR MESSAGES
C
9000  WRITE(1,9010)IERR
9010  FORMAT(1X,'ERROR ',I3,' IN OPENING DEMO.SCREEN.FT')
      RETURN
9100  WRITE(1,9110)IERR,SPFNAM
9110  FORMAT(1X,'ERROR ',I3,' IN OPENING ',7A2)
      RETURN
      END
```

```
C GFUNCT: GET FUNCTION, MAIN MENU
C
C     ****************************************************************
C     *                                                              *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C     *          VERSION 1.0     JUNE 1,1980                         *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C     *                                                              *
C     ****************************************************************
C
C     * CALLED BY: AI                                                *
C     * FUNCTION: GET MENU FUNCTION - INSPECT,PLAN,QUERY RESULTS,EXIT *
C
        SUBROUTINE GFUNCT(MENU)
C
10      WRITE(1,20)
20      FORMAT(//,'MAIN MENU:'/
     E1X,'0   EXIT'/
     11X,'1   PERFORM AN INSPECTION'/
     21X,'2   PLANNING FUNCTIONS'/
     31X,'3   QUERY INSPECTION RESULTS')
        READ(1,30,ERR=40)MENU
30      FORMAT(I1)
        IF (MENU .LT. 0 .OR. MENU .GT. 3) GOTO 10
        RETURN
40      MENU = 0
        RETURN
        END
```

C GIIN: GET INSPECTOR INPUT: INSPECTOR ID, PAGE 0001

```
C GIIN: GET INSPECTOR INPUT: INSPECTOR ID, PART#,  TESTNAME, SERIAL#
C
C     **************************************************************
C     *                                                            *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM      *
C     *          VERSION 1.0    JUNE 1,1980                        *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY     *
C     *                                                            *
C     **************************************************************
C
C     *CALLED BY: INSP                                             *
C     *FUNCTION: GET INSPECTION INFORMATION WITH SCREEN EDITOR     *
C
      SUBROUTINE GIIN(IID,PART,TESTID,SERIAL,IERR)
C
      DIMENSION IBUF(36)
C MOVE DATA TO EDIT BLOCK
C
      CALL MSUB$A(IID,10,1,10,IBUF,70,1,10)
      CALL MSUB$A(PART,20,1,20,IBUF,70,11,30)
      CALL MSUB$A(TESTID,20,1,20,IBUF,70,31,50)
      CALL MSUB$A(SERIAL,20,1,20,IBUF,70,51,70)
C OPEN SCREEN FILE
C----------
       CALL VOPEN$('DEMO.SCREEN.FT',14,1,ICHN,IERR)
       IF (IERR .EQ. 0) GOTO 20
       WRITE(1,10)IERR
10     FORMAT(1X,'ERROR ',I2,' IN OPENING DEMO.SCREEN.FT')
       RETURN
C SET UP PEDIT PARAMETERS
C----------
20    IS = 0
      IE = 4
      NEWSCR = 2      /* DO NOT ERASE SCREEN TO START
C GET OPERATOR'S INPUT
C----------
25    CALL PEDIT(ICHN,IBUF,IS,IE,NEWSCR)
C MAKE SURE SERIAL# NE 0
C----------------------
      IF (IBUF(26) .NE. 0) GOTO 40
      WRITE(1,30)
30    FORMAT(1X,'SERIAL NO. MANDATORY!')
      GOTO 25
C LOAD INPUT DATA INTO PARAMETER VARIABLES
C----------
40    CALL MSUB$A(IBUF,70,1,10,IID,10,1,10)
      CALL MSUB$A(IBUF,70,11,30,PART,20,1,20)
      CALL MSUB$A(IBUF,70,31,50,TESTID,20,1,20)
      CALL MSUB$A(IBUF,70,51,70,SERIAL,20,1,20)
C CLOSE SCREEN FILE
C----------
      CALL CLOS$A(ICHN)
      RETURN
      END
```

```
C     GPFNCT: GET PLAN FUNCTION
C
C      ****************************************************************
C      *                                                              *
C      *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C      *          VERSION 1.0    JUNE 1,1980                          *
C      *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C      *                                                              *
C      ****************************************************************
C
C      *CALLED BY: PLAN                                               *
C      *FUNCTION:  GET PLANNING FUNCTION FROM OPERATOR                *
C
        SUBROUTINE GPFNCT(MENU)
C
5       WRITE (1,10)
10      FORMAT(/,'MENU:'/,
     1    ' 1  CREATE NEW PLAN',/
     2    ' 2  CREATE NEW TEST PROCEDURE',/
     3    ' 3  CREATE NEW IMAGE COMMAND',/
     4    ' 4  MAKE NEW PLAN FROM OLD',/
     5    ' 5  MAKE NEW TEST FROM OLD',/
     6    ' 6  MAKE NEW IMAGE COMMAND FROM OLD',/
     7    ' 7  MODIFY PLAN',/
     8    ' 8  MODIFY TEST PROCEDURE',/
     9    ' 9  MODIFY IMAGE COMMAND',/
     .    '10  DELETE PLAN',/
     1    '11  DELETE TEST PROCEDURE',/
     2    '12  DELETE TEST RESULTS',/
     3    '13  DELETE IMAGE COMMAND',/
     4    '14  DISPLAY DATA',/)
        CALL READN('? ',2,MENU)
        IF (MENU .LT. 1) RETURN
        IF (MENU .GT. 14) GOTO 5
        RETURN
        END
```

```
C  GPLNM: GET PLAN RECORD
C
C    ***********************************************************
C    *                                                         *
C    *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM   *
C    *          VERSION 1.0    JUNE 1,1980                     *
C    *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY  *
C    *                                                         *
C    ***********************************************************
C
C    *CALLED BY: INSP                                          *
C    *FUNCTION: 1.  CREATE THE PLAN KEYWORD                    *
C    *          2.  FIND THE PLAN RECORD                       *
C    *          3.  IF PLAN RECORD NON-EXISTANT, MAY USE DEFAULT PLAN*
C
      SUBROUTINE GPLNM(PART,TESTID,DEFALT,IERR)
C
$INSERT PCOM
$INSERT SYSCOM>PARM.K
$INSERT SYSCOM>A$KEYS
C
      INTEGER KEY(15),DPLAN(15)
      LOGICAL DEFALT,YES,YSNO$A
C
      CALL CRPKEY(PART,20,TESTID,20,0,0,0,0,KEY,30)/*CREATE KEYWORD
C     WRITE(1,1000)KEY
1000  FORMAT(1X,'KEY: ',15A2)
      DEFALT = .FALSE.
10    CALL ZFIL(PREC,PSZB,0)  /*INITIALIZE PREC
      IFLAG = FL$RET
C     WRITE(1,1000)KEY
C     CALL TDUMP(KEY,30)
      CALL NEXT$(PCHN,PREC,KEY,PLARR,IFLAG,$9000,0,0,0,0)
C     WRITE(1,1001)
1001  FORMAT(1X,'NO ERROR FROM NEXT$')
      IERR = 0
      RETURN
C
9000  IERR = PLERR
C     WRITE(1,1002)IERR
1002  FORMAT(1X,'ERROR ',I2)
      IF(PLERR.EQ.7) GOTO 9100
      IF(PLERR.NE.22 .OR. PLERR .NE. 24) GOTO 9900
      CALL RECYCL
      GO TO 10              /* TRY AGAIN
C
C     Record does not exist
9100  YES =  YSNO$A('NOT FOUND. USE DEFAULT PLAN',27,A$DNO)
      IF (YES) GOTO 9200
      IERR = -1
      RETURN
9200  CALL ZMVD('DEFAULT PLAN/DEFAULT          ',KEY,30)
      DEFALT = .TRUE.
      GOTO 10
9900  WRITE(1,9910)PLERR,KEY
9910  FORMAT(1X,'MIDAS ERROR ',I3,' IN LOCATING ',15A2)
      RETURN
      END
```

```
C GPTST: GET A TEST PLAN
C
C     *************************************************************
C     *                                                           *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM     *
C     *          VERSION 1.0    JUNE 1,1980                       *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY    *
C     *                                                           *
C     *************************************************************
C
C     *CALLED BY: DINSP                                           *
C     *FUNCTION: 1.  GET TEST PLAN RECORD                         *
C     *          2.  DISPLAY TEST DESCRIPTION                     *
C
C
      SUBROUTINE GPTST(ITEST,IERR)
C
C   ITEST = TEST SEQUENCE NUMBER
C
C
$INSERT PCOM
$INSERT PTCOM
$INSERT SYSCOM>PARM.K
C
      EQUIVALENCE (PDA,LPDA), (PDB,LPDB), (PDC,LPDC), (PDD,LPDD)
C
      IBIAS = 22 + (ITEST-1)*PNWT
      IFLAG = FL$RET
10    CALL NEXT$(PTCHN,PTREC,PREC(IBIAS),PTARR,IFLAG,$9000,0,0,0,0)
C
C  DISPLAY DESCRIPTION TEXT
C-----------------------------
      WRITE (1,15)
15    FORMAT(/)
      IF (LPDA .EQ. 0) GOTO 30
      WRITE (1,20) PDA
      IF (LPDA .EQ. 0) GOTO 30
      WRITE (1,20) PDB
      IF (LPDC .EQ. 0) GOTO 30
      WRITE (1,20) PDC
      IF (LPDD .EQ. 0) GOTO 30
      WRITE (1,20) PDD
20    FORMAT(39A2)
30    WRITE (1,40)
40    FORMAT(/)
      RETURN
C
C
9000  IERR = PTERR
      IF(PTERR.NE.22 .OR. PTERR .NE. 24) GOTO 9900
      WRITE(1,1002)   /* ***CHECKOUT***
1002  FORMAT(1X,'CALLING RECYCLE')
      CALL RECYCL
      GO TO 10              /* TRY AGAIN
9900  IF (PTERR .NE. 7) GOTO 9905
      WRITE(1,9901)PTNM,PTNAM
9901  FORMAT(1X,'TEST ',10A2,' NOT FOUND IN DATA BASE ',16A2)
      RETURN
9905  WRITE(1,9910)PTERR,PTNM,PTNAM
9910  FORMAT(1X,'MIDAS ERROR ',I3,' IN TEST ',16A2/1X,
     C'FROM DATA BASE ',16A2)
      RETURN
      END
```

```
C GRFNCT: GET RETRIEVAL FUNCTION
C
C     ****************************************************************
C     *                                                              *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C     *          VERSION 1.0    JUNE 1,1980                          *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C     *                                                              *
C     ****************************************************************
C
C     *CALLED BY: RETR                                               *
C     *FUNCTION:  GET RETRIEVAL FUNCTION FROM OPERATOR               *
C
C ARG 1: MENU   INTEGER
C
      SUBROUTINE GRFNCT(MENU)
C
5     WRITE(1,10)
10    FORMAT(1X,/,'HISTORY MENU'/,
     . ' 0   EXIT',/,
     1 ' 1   RETRIEVE AN IMAGE FOR DISPLAY'/,
     2 ' 2   RECREATE ONE TEST RESULT'/,
     3 ' 3   RECREATE AN INSPECTION',/,
     4 ' 4   DISPLAY MAIN RESULTS',/,
     5 ' 5   DISPLAY TEST RESULTS',/,
     6 ' 6   DISPLAY TAPE RECORD',/,
     7 ' 7   LIST INDECIES')
      READ(1,20,ERR = 30)MENU
20    FORMAT(I1)
      IF (MENU .LT. 0 .OR. MENU .GT. 7) GOTO 5
30    RETURN
      END
```

```
C INITAL: SET UP TERMINAL CODES AND OPEN DATA BASE FILES
C
C     ***************************************************************
C     *                                                             *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C     *          VERSION 1.0    JUNE 1,1980                         *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C     *                                                             *
C     ***************************************************************
C
C     * CALLED BY: AI                                               *
C     * FUNCTION: 1.  SET UP DATA BASE PARAMETERS (DBPRM)           *
C     *           2.  OPEN DATA BASE FILES                          *
C
      SUBROUTINE INITAL(IERR)
C
$INSERT PCOM
$INSERT RCOM
$INSERT PTCOM
$INSERT RTCOM
$INSERT TCOM
$INSERT CCOM
$INSERT SYSCOM>KEYS.F
C
      INTEGER TYPE
C
C SET UP TERMINAL CODES
C----------
      CALL SETERM(TYPE)
      IF (TYPE .GT. 0 .AND. TYPE .LT. 4) GOTO 10
      IERR = 17
      IF (TYPE .EQ. 4) GOTO 4
      RETURN
4     CALL TONL
      CALL TNOU ('This program will not run on your terminal.',43)
      RETURN
C
C GET DATA BASE PARAMETERS
C----------
10    CALL DBPRM
C
C OPEN PLAN DATA BASE FILES
C----------
      CALL VOPEN$(PLNAM,PLLEN,1,PCHN,IERR)
      IF (IERR .EQ. 0) GOTO 30
      WRITE(1,20)IERR,PLNAM
20    FORMAT(1X,'ERROR ',I2,' IN OPENING ', 16A2)
      RETURN
C
30    CALL VOPEN$(PTNAM,PTLEN,1,PTCHN,IERR)
      IF (IERR .EQ. 0) GOTO 40
      WRITE(1,20)IERR,PTNAM
      CALL CLOALL
      RETURN
C
C OPEN RESULTS DATA BASE FILES
C----------
40    CALL VOPEN$(RLNAM,RLLEN,1,RLCHN,IERR)
      IF (IERR .EQ. 0) GOTO 50
      WRITE(1,20)IERR,RLNAM
      CALL CLOALL
      RETURN
C
50    CALL VOPEN$(RTNAM,RTLEN,1,RTCHN,IERR)
      IF (IERR .EQ. 0) GOTO 60
      WRITE(1,20)IERR,RTNAM
      CALL CLOALL
      RETURN
C
C OPEN TAPE DATA BASE FILE
C----------
60    CALL VOPEN$(TPNAM,TPLEN,1,TCHN,IERR)
      IF (IERR .EQ. 0) GOTO 70
      WRITE(1,20)IERR,TPNAM
      CALL CLOALL
```

```
      RETURN
C
C OPEN COMMAND DATA BASE FILE
C----------
70    CALL VOPEN$(CNNAM,CLEN,1,CCHN,IERR)
      IF (IERR .EQ. 0) GOTO 80
      WRITE(1,20)IERR,CNNAM
      CALL CLOALL
80    RETURN
      END
```



```
C INSP: PERFORM AN INSPECTION
C
C    ****************************************************************
C    *                                                              *
C    *           REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C    *           VERSION 1.0    JUNE 1,1980                         *
C    *           BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C    *                                                              *
C    ****************************************************************
C
C    *CALLED BY: AI                                                 *
C    *FUNCTION: 1. GET INSPECTOR ID,PART#,TEST,SERIAL# (GIIN)       *
C    *          2. GET THE PLAN (GPLNM)                             *
C    *          3. DO THE INSPECTION (DINSP)                        *
C
      SUBROUTINE INSP(EQUIP,IERR)
C
      INTEGER IID(5),PART(10),TESTID(10),SERIAL(10)
      LOGICAL DEFALT,EQUIP,MORE
C
C GET INSPECTOR INPUT: INSPECTOR ID, PART#, TESTNAME, SERIAL#
C----------
10    CALL GIIN(IID,PART,TESTID,SERIAL,IERR)
      IF (IERR. NE. 0) RETURN
C
C GET PLAN RECORD
C----------
      CALL GPLNM(PART,TESTID,DEFALT,IERR)
      IF (IERR) 20,30,200
C
20    IERR = 0
      GOTO 100
C
C DO THE INSPECTION
C----------
30    CALL DINSP(IID,SERIAL,EQUIP,DEFALT,IERR)
      IF (IERR .NE. 0) RETURN
C
C DO MORE?
C----------
100   CALL DMORE(MORE)
      IF (MORE) GOTO 10
200   RETURN
      END
C
```

```
C INTAP: INITIALIZE TAPE
C
C     ****************************************************************
C     *                                                              *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C     *          VERSION 1.0    JUNE 1,1980                          *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C     *                                                              *
C     ****************************************************************
C
C     *CALLED BY: DINSP                                              *
C     *FUNCTION: 1. ASKS IF MAG TAPE NEEDED                          *
C     *          2. ASSURES THAT CORRECT TAPE IS ON-LINE             *
C     *          3. ASSURES THAT TAPE IS AT CORRECT POSITION         *
C     *          4. GETS TAPE RECORD                                 *
C
        SUBROUTINE INTAP(EQUIP,NOTAPE,IERR)
C
C   EQUIP  = EQUIP INITIALIZED FLAG
C   NOTAPE = TAPE INUSE FLAG, RETURNED
C   IERR   = ERROR RETURNED
C
$INSERT TCOM
$INSERT SYSCOM>PARM.K
$INSERT SYSCOM>A$KEYS
C
        LOGICAL YSNO$A,NEW,CSTR$A,NOTAPE,YES,EQUIP,ITAPE,NTAP
        INTEGER STATUS(3),NAME(10)
C
C
        IF (.NOT. EQUIP) GOTO 10        /* IS EQUIPMENT INITIALIZED?
        YES = YSNO$A('DOES THIS INSPECTION REQUIRE MAG TAPE',37,A$DNO)
        IF (YES) NOTAPE = .FALSE.
C                                             PAST     PRESENT
        IF (.NOT. YES .AND. NOTAPE) RETURN /*   NOTAPE  NOTAPE
        IF (.NOT. NOTAPE .AND. YES) GOTO 5 /*   TAPE    TAPE
        IF (NOTAPE .AND. YES) GOTO 2      /*   NOTAPE  TAPE
        IF (.NOT.NOTAPE .AND. .NOT. YES) GOTO 12 /*TAPE NOTAPE
C
2       NTAP = YSNO$A('IS CORRECT TAPE MOUNTED AND READY',33,A$DNO)
        IF (.NOT. NTAP) GOTO 1
        IF (TNAM(1) .EQ. 0) GOTO 15
        GOTO 5
C
5       IF (TNFL + 1 .EQ. TFCNT) RETURN /* IS TAPE AT CORRECT POSITION?
        WRITE(1,6)TNAM
6       FORMAT(1X,'CURRENT TAPE ON LINE: ',10A2)
        ITAPE = YSNO$A('IS THIS CORRECT',15,A$DNO)
        IF (ITAPE) GOTO 8
C
1       WRITE(1,7)
7       FORMAT(1X,'PLEASE MOUNT NEW TAPE: HIT ANY KEY WHEN READY')
        CALL PAUS(J)
        GOTO 14
C
8       N = TNFL - TFCNT + 1
        GOTO 70
C
10      CALL ZFIL(TREC,TSZB,0)
        CALL TONL
11      YES = YSNO$A('DOES THIS INSPECTION REQUIRE MAG TAPE',37,A$DNO)
12      IF (.NOT. YES) NOTAPE = .TRUE.
        IF (.NOT. YES) RETURN
        NOTAPE = .FALSE.
C
C GET TAPE NAME
C--------------
14      CALL ZFIL(TREC,TSZB,0)
        CALL TONL
15      CALL TNOUA('TAPE NAME (ENTER "NEW" IF A NEW TAPE) ',38)
        CALL READL(TNAM,NCHAR,20)
        NEW = CSTR$A(TNAM,NCHAR,'NEW',3)
        IF (.NOT.NEW) GOTO 30
C
C  NEW TAPE, ADD IT TO THE DATA-BASE
```

```
C-----------------------------------
25      CALL TNOUA('ENTER NEW TAPE NAME: ',21)
        CALL READL(TNAM,NCHAR,20)
        CALL ADD1$(TCHN,TREC,TNAM,TPARR,FL$RET,$9000,0,0,0,0)
        GOTO 50
C
C EXISTING TAPE - FIND IN DATA BASE
C-----------------------------------
30      CALL NEXT$(TCHN,TREC,TNAM,TPARR,FL$RET,$9100,0,0,0,0)
C
C  CHECK THE TAPE FOR ONLINE
C---------------------------
50      TFCNT = 1        /* PRESENT FILE NO.
        CALL T$MT(0,LOC(TREC),0,:100000,STATUS)
        IF (AND(:300,STATUS(2)) .NE. :300) GOTO 9200
C
C REWIND TAPE
C----------
60      CALL T$MT(0,LOC(TREC),0,:40,STATUS)
        IF(AND(STATUS(2),1) .EQ. 0) GOTO 60
C
C  MOVE TO CORRECT PLACE ON TAPE
C--------------------------------
        N = TNFL
70      IF (N .EQ. 0) RETURN
        CALL T$MT(0,LOC(TREC),0,:22200,STATUS)  /*MOVE TAPE 1 FILE
        IF (STATUS(1) .EQ. 0) GOTO 90
80      CALL T$MT(0,LOC(TREC),0,:100000,STATUS)
        IF (STATUS(1) .NE. 0) GOTO 80
90      N = N - 1
        TFCNT = TFCNT + 1
        GOTO 70
C
9000    IF (TPERR .NE. 12) GOTO 9010
        WRITE (1,9001) TNAM
9001    FORMAT(/,10A2,' ALREADY EXISTS.')
        GOTO 10
9010    IERR = TPERR
        WRITE (1,9011) IERR,TNAM
9011    FORMAT('MIDAS ERROR =',I3,', KEY = ',10A2)
        RETURN
C
9100    IERR = TPERR
        IF(TPERR.NE.7) GOTO 9150
C
C RECORD NOT FOUND
        WRITE(1,9160)
9160    FORMAT(1X,'RECORD NOT FOUND')
        IERR = 0
        GOTO 11 /*GIVE OPERATOR ANOTHER CHANCE
9150    IF(TPERR.NE.22 .OR. TPERR .NE. 24) GOTO 9190
        CALL RECYCL
        GOTO 30                  /* TRY AGAIN
9190    WRITE (1,9191)IERR,TNAM
9191    FORMAT('MIDAS ERROR:',I3,', TAPE # ',10A2)
        RETURN
C
9200    WRITE(1,9210)
9210    FORMAT(1X,'PLEASE MOUNT TAPE AND PUT ONLINE')
        DO 9211 I = 1,3
        CALL TOOCT(STATUS(I))
9211    CALL TNOUA(' ',1)
        CALL PAUS(J)
        GOTO 50
        END
```

```
C   INTIP: INITIALIZE THE IMAGE PROCESSOR & SYSTEM 500 SUBSYSTEM
C
C    ************************************************************
C    *                                                          *
C    *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM    *
C    *          VERSION 1.0    JUNE 1,1980                      *
C    *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY   *
C    *                                                          *
C    ************************************************************
C
      SUBROUTINE INTIP(IERR)
C
C
C
      INTEGER ZERO
      INTEGER DIGIT(40)
      COMMON /OREZ/ ZERO(8191)
      DATA DIGIT/'>DIGITIZE>$A; ',33*'  '/
C
C
C  IS THE IMAGE PROCESSOR ON?
C
      CALL TONL
      CALL TNOUA('POWER ON THE MODEL 70 & HIT A KEY ',34)
      CALL PAUS(J)
C
      ZERO(3029)=50
      ZERO(3053)=0
      ZERO(3054)=0
C
C
C  LOAD COMMON
C
      CALL CMLDR
C
C  CLEAN THE DIRECTORY AND INITIALIZE M70
C
      CALL ICLEAN
C
C TURN ON THE CAMERA
C
      CALL CMDM70(DIGIT,IERR)
C
      RETURN
      END
```

```
C INTMOT: INITIALIZE MOTORS
C
C     ****************************************************************
C     *                                                              *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C     *          VERSION 1.0     JUNE 1,1980                         *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C     *                                                              *
C     ****************************************************************
C
      SUBROUTINE INTMOT(IER)
C
$INSERT SYSCOM>A$KEYS
C
      LOGICAL YSNO$A
      PARAMETER NMOT = 5
      INTEGER MOTOR(NMOT),STATUS
C
C   MOTOR I POSITIONING IMPLEMENTED IF MOTOR(I) = 1
C    *** NOTE: MOTOR NUMBERS START AT 0! ***
      DATA MOTOR /0,0,1,0,0/
C
C   RESET THE ABORT IF SET
C
10    CALL MOTION(:140000,0,0,IER)
      IF (IER-1) 20,15,900
15    CALL TNOUA('PUT MOTOR CONTROL IN REMOTE, HIT ANY KEY ',41)
      CALL PAUS(IGO)
      GO TO 10
C
C   ASK OPERATOR IF STANDARDIZATION IS NECESSARY
C
20    IF (.NOT.YSNO$A(
     1    'HAS COUNTER BEEN FIXED SINCE LAST POWER-UP',42,A$DNO))
     2    GOTO 80
C
C OPERATOR THINKS EVERYTHING IS OK.
C
40    CALL POSIT(2,IVAL,STATUS)
      IF (STATUS-1) 50,45,900
45    CALL TNOUA('PUT MOTOR CONTROL IN REMOTE, HIT ANY KEY ',41)
      CALL PAUS(IGO)
      GO TO 40
C
50    WRITE(1,51)IVAL
51    FORMAT(1X,'COUNTER SAYS YOU ARE AT ',I6)
      IF (YSNO$A('IS THIS CORRECT',15,A$DNO)) RETURN
C
C
80    DO 100 N=1,NMOT
      IF (MOTOR(N) .EQ. 0) GOTO 100
      MOT = N - 1
      CALL POSINT(MOT,IER)
      IF (IER .NE. 0) RETURN
100   CONTINUE
900   RETURN
C
      END
```

```
C LISTIX: LIST KEYNAMES BY INDEX#
C
C     ***************************************************************
C     *                                                             *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C     *          VERSION 1.0    JUNE 1,1980                         *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C     *                                                             *
C     ***************************************************************
C
C     *CALLED BY: DSPLD AND RETR
C     *FUNCTION : 1. GET WHAT DATA OPERATOR WANTS TO VIEW AND INDEX# *
C     *           2. SET LENGTH OF KEYWORD AND DATA BASE CHANNEL #   *
C     *           3. GET REQUESTED DATA                              *
C     *           4. DISPLAY/PRINT THE DATA                          *
C
C ARG 1: SPOOL CHAN #
C
      SUBROUTINE LISTIX(SPCHN)
C
$INSERT PCOM
$INSERT PTCOM
$INSERT RCOM
$INSERT RTCOM
$INSERT TCOM
$INSERT SYSCOM>PARM.K
C
      INTEGER RMPRI             /* RESULTS MAIN PRIMARY KEYWORD SIZE
      PARAMETER RMPRI = 20
      INTEGER TMREC(TSZW),TMARRY(14),TMERR,TMKEY(TNWT),TMCHR,TMWDS
      EQUIVALENCE(TMARRY,TMERR)
C
C GET MENU#
C
10    WRITE(1,20)
20    FORMAT(1X,/,'LIST INDICIES MENU'/
     . 1X,'00   EXIT'/
     . 1X,'10   PLANS BY NAME'/
     . 1X,'11   PLANS BY TEST NAME'/
     . 1X,'20   TEST NAMES'/
     . 1X,'30   RESULTS BY NAME'/
     . 1X,'31   RESULTS BY TEST NAME'/
     . 1X,'40   TEST RESULTS'/
     . 1X,'50   TAPE NAMES'/
     . 1X,'51   IMAGE NAME'/)
      READ(1,30,ERR=210)N,I
30    FORMAT(2I1)
      WRITE (1,33)
33    FORMAT(/)
C
C CHECK FOR VALIDITY OF MENU SELECTION
C
      IF (N .GT. 0 .AND. N .LE. 5) GOTO 40
      IF (N .LE. 0) RETURN
      GOTO 10
40    IF (I .GE. 0 .AND. I .LE. 1) GOTO 50
      GOTO 10
C
50    IFLAG = FL$RET + FL$UKY + FL$FST
C
C SET MIDAS CHANNEL,#CHAR IN KEYWORD
C
      GOTO (110,120,130,140,150),N
C
C PLAN
C
110   MCHN = PCHN
      IF (I .EQ. 0) TMCHR = 30
      IF (I .EQ. 1) TMCHR = PNWT*2
      GOTO 160
C
C PLAN TEST
C
120   MCHN = PTCHN
      TMCHR = 20
```

```
      GOTO 160
C
C RESULTS
C
130   MCHN = RLCHN
      IF (I .EQ. 0) TMCHR = RMPRI*2
      IF (I .EQ. 1) TMCHR = RNWT*2
      GOTO 160
C
C RESULTS TEST
C
140   MCHN = RTCHN
      TMCHR = RNWT*2
      GOTO 160
C TAPE
150   MCHN = TCHN
      IF (I .EQ. 0) TMCHR = 20
      IF (I .EQ. 1) TMCHR = TNWT*2
C
C CALCULATE #WORDS IN KEYWORD
C
160   TMWDS = TMCHR/2
C
C SPOOL LOOP
C
170   DO 200 J = 1,22
C
C GET DATA
C
180   CALL NEXT$(MCHN,TMREC,TMKEY,TMARRY,IFLAG,$9000,I,0,0,0)
      IFLAG = FL$USE + FL$RET + FL$PLW + FL$UKY
      IF (SPCHN .NE. 0) GOTO 190
C
C OUTPUT LINE TO TERMINAL
C
      CALL TNOU(TMKEY,TMCHR)
      GOTO 200
C
C OUTPUT LINE TO SPOOL FILE
C
190   CALL WTLIN$(SPCHN,TMKEY,TMWDS,IERR)
      IF (IERR .NE. 0) GOTO 9100
200   CONTINUE
C
C END OF SPOOL LOOP - GO BACK AND GET MORE
C
C
      IF (SPCHN .NE. 0) GOTO 170
      CALL PAUS(J)
      IF (J .NE. 0) GOTO 170
210   RETURN
C
C ERRORS
C
9000  IF (TMERR .NE. 7) GOTO 9005
      WRITE (1,33)
      J = 1
      IF (SPCHN .EQ. 0) CALL PAUS(J)
      IF (J .EQ. 0) RETURN
      GOTO 10
9005  IF (TMERR .NE. 22 .AND. TMERR .NE. 24) GOTO 9010
      CALL RECYCL
      GOTO 180
9010  WRITE(1,9020)TMERR,TMKEY
9020  FORMAT(1X,'MIDAS ERROR ',I3,' IN FINDING ',25A2)
      RETURN
C
9100  WRITE(1,9110)IERR,SPCHN,TMKEY
9110  FORMAT(1X,'ERROR ',I3,' IN WRITING TO SPCHN ',I3,'KEY= ',25A2)
      RETURN
C
      END
```

```
C MDFYC: MODIFY IMAGE PROCESSOR COMMAND
C
C     ****************************************************************
C     *                                                              *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C     *          VERSION 1.0    JUNE 1,1980                          *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C     *                                                              *
C     ****************************************************************
C
C     *CALLED FROM: PLAN                                             *
C     *FUNCTION: 1. GET COMMAND NAME FROM OPERATOR                   *
C     *          2. GET COMMAND RECORD FROM DATA BASE                *
C     *          3. EDIT THE RECORD                                  *
C     *          4. STORE THE NEW RECORD IN DATA BASE                *
C
      SUBROUTINE MDFYC(IER)
C
$INSERT CCOM
$INSERT SYSCOM>A$KEYS
$INSERT SYSCOM>PARM.K
C
C
      INTEGER NAME(16)
C
      DATA NAME /'DEMO.SCREEN.FT                  '/
C
C   Open a channel to the screen template file
C---------------------------------------------
      CALL VOPEN$(NAME,32,1,IFCH,IER)      /* OPEN FOR READ
      IF (IER .NE. 0) GOTO 9000
C
      IS = 318
      IE = 319
      NEWSCR = 2       /* DO NOT ERASE THE SCREEN TO START
C
C  Clear record buffer
C--------------------
10    CALL ZFIL(CREC,CSZB,0)
C
C
C   Get the test name.
C--------------------
20    CALL PEDIT(IFCH,CREC,IS,IE,NEWSCR)
C
C   Get the record for editing.
C-----------------------------
30    CALL LOCK$(CCHN,CREC,CNAM,CARR,FL$RET,$9100,0,0,0,0)
C
C   Edit the file
C---------------
      IS = 318
      IE = 330
      CALL PEDIT(IFCH,CREC,IS,IE,NEWSCR)
C
C  Store the record
C------------------
      CALL UPDAT$(CCHN,CREC,CNAM,CARR,FL$USE,$9200,0,0,0,0)
C
C   MORE?
C--------
300   IF (YSNO$A('More',4,A$DNO)) GOTO 20
C
C   CLOSE THE SCREEN CHANNEL NO.
C------------------------------
400   CALL CLOS$A(IFCH)
      RETURN
C
9000  WRITE (1,9001) IER,NAME
9001  FORMAT('ERROR ',I3,',  OPENING FILE ',16A2)
      RETURN
C
9100  IF (CERR .NE. 7) GOTO 9110
      WRITE (1,9101) CNAM
9101  FORMAT(10A2,' NOT FOUND')
```

```
      GOTO 300
9110  IF (CERR .EQ. 22) GOTO 30
      IF (CERR .EQ. 24) GOTO 30
      WRITE (1,9111) PTERR,PTNM
9111  FORMAT('MIDAS LOCK ERROR =',I3,' KEY = ',15A2)
      GOTO 400
C
C
9200  WRITE (1,9101) CERR,CNNAM
9201  FORMAT('MIDAS UPDAT ERROR =',I3,' KEY = ',15A2)
      GOTO 400
C
C
      END
```



```
C  MDFYP:  MODIFY PLAN
C
C    ***********************************************************
C    *                                                         *
C    *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM   *
C    *          VERSION 1.0    JUNE 1,1980                     *
C    *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY  *
C    *                                                         *
C    ***********************************************************
C
      SUBROUTINE MDFYP(IER)
C
C    *CALLED FROM: PLAN                                        *
C    *FUNCTION: 1. ASK OPERATOR FOR PARTN, INSPECTION NAME     *
C    *          2. GET THE PLAN RECORD                         *
C    *          3. ALLOW OPERATOR TO MODIFY THE PLAN RECORD    *
C    *          4. DELETE OLD AND INSERT NEW SECONDARY KEYS    *
C
      IER = 0
      CALL TNOU ('NOT IMPLEMENTED!',16)
      RETURN
      END
```

```
C MDFYT: MODIFY TEST PROCEDURE
C
C     ***********************************************************
C     *                                                         *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM   *
C     *          VERSION 1.0    JUNE 1,1980                     *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY  *
C     *                                                         *
C     ***********************************************************
C
C     *CALLED FROM: PLAN                                           *
C     *FUNCTION: 1. GET TEST NAME FROM OPERATOR                    *
C     *          2. GET TEST RECORD FROM DATA BASE                 *
C     *          3. EDIT THE RECORD                                *
C     *          4. STORE THE NEW RECORD IN DATA BASE              *
C
        SUBROUTINE MDFYT(IER)
C
$INSERT PTCOM
$INSERT SYSCOM>A$KEYS
$INSERT SYSCOM>PARM.K
C
C
        INTEGER NAME(16)
        INTEGER KEYO(10)        /* PRIMARY KEY
C
        DATA NAME /'DEMO.SCREEN.FT                   '/
C
C    Open a channel to the screen template file
C-----------------------------------------------
        CALL VOPEN$(NAME,32,1,IFCH,IER)      /* OPEN FOR READ
        IF (IER .NE. 0) GOTO 9000
C
        IS = 197
        IE = 199
        NEWSCR = 2      /* DO NOT ERASE THE SCREEN TO START
C
C   Clear record buffer
C---------------------
10      CALL ZFIL(PTREC,PTSZB,0)
C
C
C    Get the test name.
C---------------------
20      CALL PEDIT(IFCH,PTREC,IS,IE,NEWSCR)
C
C    Get the record for editing.
C------------------------------
30      CALL LOCK$(PTCHN,PTREC,PTNM,PTARR,FL$RET,$9100,0,0,0,0)
C
C    Edit the file
C---------------
        IS = 275
        IE = 297
        CALL PEDIT(IFCH,PTREC,IS,IE,NEWSCR)
C
C   Store the record
C-----------------
        CALL UPDAT$(PTCHN,PTREC,PTNM,PTARR,FL$USE,$9200,0,0,0,0)
C
C    MORE?
C--------
300     IF (YSNO$A('More',4,A$DNO)) GOTO 20
C
C    CLOSE THE SCREEN CHANNEL NO.
C-------------------------------
400     CALL CLOS$A(IFCH)
        RETURN
C
9000    WRITE (1,9001) IER,NAME
9001    FORMAT('ERROR ',I3,',  OPENING FILE ',16A2)
        RETURN
C
9100    IF (PTERR .NE. 7) GOTO 9110
        WRITE (1,9101) PTNM
```

```
9101   FORMAT(10A2,' NOT FOUND')
       GOTO 300
9110   IF (PTERR .EQ. 22) GOTO 30
       IF (PTERR .EQ. 24) GOTO 30
       WRITE (1,9111) PTERR,PTNM
9111   FORMAT('MIDAS LOCK ERROR =',I3,' KEY = ',15A2)
       GOTO 400
C
C
9200   WRITE (1,9101) PTERR,PTNM
9201   FORMAT('MIDAS UPDAT ERROR =',I3,' KEY = ',15A2)
       GOTO 400
C
C
       END
```



```
C  MKFMC: MAKE IMAGE COMMAND FROM OLD
C
C    ****************************************************************
C    *                                                              *
C    *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C    *          VERSION 1.0    JUNE 1,1980                          *
C    *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C    *                                                              *
C    ****************************************************************
C
       SUBROUTINE MKFMC(IER)
C
C    *CALLED FROM: PLAN                                             *
C    *FUNCTION: 1. ASK OPERATOR FOR COMMAND, INSPECTION NAME        *
C    *          2. GET THE COMM RECORD                              *
C    *          3. ALLOW OPERATOR TO MODIFY THE COMM RECORD         *
C    *          4. WRITE NEW RECORD                                 *
C
       IER = 0
       CALL TNOU ('NOT IMPLEMENTED!',16)
       RETURN
       END
```

C MKFMP: MAKE NEW PLAN FROM OLD.

```
C  MKFMP:  MAKE NEW PLAN FROM OLD.
C
C     ****************************************************************
C     *                                                              *
C     *           REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C     *           VERSION 1.0     JUNE 1,1980                        *
C     *           BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C     *                                                              *
C     ****************************************************************
C
      SUBROUTINE MKFMP(IER)
C
C     *CALLED FROM: PLAN                                               *
C     *FUNCTION: 1. GET OLD PLAN NAME FROM OPERATOR                    *
C     *          2. GET NEW PLAN NAME FROM OPERATOR                    *
C     *          3. CHECK FOR EXISTANCE OF NEW PLAN NAME               *
C     *          4. EDIT OLD PLAN                                      *
C     *          5. INSERT NEW PLAN INTO DATA BASE                     *
C
      IER = 0
      CALL TNOU ('NOT IMPLEMENTED!',16)
      RETURN
      END
```

C MKFMT: MAKE A NEW TEST PLAN FROM OLD.

```
C  MKFMT:  MAKE A NEW TEST PLAN FROM OLD.
C
C     ****************************************************************
C     *                                                              *
C     *           REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C     *           VERSION 1.0     JUNE 1,1980                        *
C     *           BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C     *                                                              *
C     ****************************************************************
C
      SUBROUTINE MKFMT(IER)
C
C     *CALLED BY: PLAN                                                 *
C     *FUNCTION: 1. GET OLD AND NEW TEST NAMES FROM OPERATOR           *
C     *          2. CHECK FOR EXISTANCE OF NEW TEST NAME               *
C     *          3. EDIT THE RECORD                                    *
C     *          4. INSERT NEW TEST INTO DATA BASE                     *
C
      IER = 0
      CALL TNOU ('NOT IMPLEMENTED!',16)
      RETURN
      END
```

```
C   MOTOR: CONTROLS MOTION OF A MOTOR
C
C    ************************************************************
C    *                                                          *
C    *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM    *
C    *          VERSION 1.0    JUNE 1,1980                      *
C    *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY   *
C    *                                                          *
C    ************************************************************
C
      SUBROUTINE MOTOR(MOT,SPEED,POS,IER)
C
      PARAMETER MSEC=1000
      INTEGER MOT,SPEED,POS,STATUS,DIR
      INTEGER SLWDN,STRBRK,TOL,DIF,VALUE,VALUE1
$INSERT SYSCOM>CRTCTRL
C
C ARGUMENTS:
C
C      MOT      =MOTOR#, FROM 0 TO 7
C
C      SPEED    =THE RELATIVE SPEED OF THE MOTOR, FROM 0 TO 127
C
C      POS      =THE TARGET POSITION THAT IS DESIRED
C
C      IER      =ERROR FLAG  0 FOR GOOD
C                            1 FOR CONTROL IN MANUAL
C                            2 GPIB ERROR
C
C PARAMETERS:
C
C      STRBRK   =THE NUMBER OF COUNTS AWAY FROM TARGET POSITION THAT THE
C                BRAKES ARE APPLIED
C      SLWDN    =THE NUMBER OF COUNTS AWAY FROM TARGET POSITION THAT THE
C                MOTOR IS SLOWED DOWN
C      TOL      =THE TOLERANCE THAT IS ALLOWED AWAY FROM TARGET POSITION
C
C SET UP THE PARAMETERS
C
      PARAMETER (STRBRK=:3,SLWDN=:100,TOL=:2)
      IER=0
C
C IF SPEED IS ZERO THEN BYPASS
C
      IF(SPEED .EQ. 0)GO TO 999
C
C FIND THE CURRENT POSITION
C
20    CALL POSIT(MOT,VALUE,STATUS)
      IF (STATUS-1) 30,950,990
C
C COMPUTE THE DIRECTION TO MOVE
C
30    IF(VALUE .GT. POS)DIR=1
      IF(VALUE .LE. POS)DIR=0
      IF(VALUE .LT. 0)DIR=0
      IF(POS .GT. VALUE)DIF=POS-VALUE
      IF(POS .LE. VALUE)DIF=VALUE-POS
      IF(DIF .LT. SLWDN)GO TO 100
C
C SEE IF THERE YET
C
      CALL MOTION(MOT,DIR,SPEED,STATUS)
40    CALL POSIT(MOT,VALUE,STATUS)
      IF (STATUS-1) 45,950,990
45    IF(POS .GT. VALUE)DIF=POS-VALUE
      IF(POS .LE. VALUE)DIF=VALUE-POS
      IF(DIF .LT. SLWDN)GO TO 100
      GO TO 40
C
C ALMOST THERE! SLOW DOWN.
C
100   IF(DIF .LT. STRBRK)GO TO 200
      SDIF=DIF
      CALL MOTION(MOT,DIR,20,STATUS)
```

AD-A098 658 BOEING AEROSPACE CO SEATTLE WA F/G 13/8

LOW COST HIGH VOLUME RADIOGRAPHIC INSPECTION.(U)

JAN 81 N M LOWRY, H J ABPLANALP, J M TANKE DAAK40-78-C-0197

UNCLASSIFIED D180-26159-1 DRSMI/RS-CR-81-1 NL

3 of 3

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END
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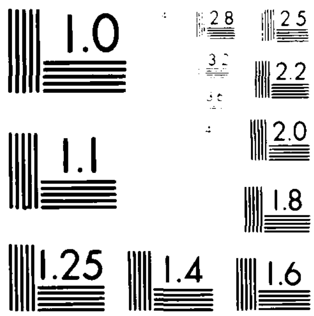

1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6
MICROCOPY RESOLUTION TEST CHART

```
110     CALL POSIT(MOT,VALUE,STATUS)
        IF (STATUS-1) 115,950,990
115     IF(POS .GT. VALUE)DIF=POS-VALUE
        IF(DIF .GT. SDIF)GO TO 20
        IF(POS .LE. VALUE)DIF=VALUE-POS
        IF(DIF .LT. STRBRK)GO TO 200
        GO TO 110
C
C PUT ON THE BRAKES
C
200     CALL MOTION(MOT,DIR,0,STATUS)
210     CALL POSIT(MOT,VALUE,STATUS)
        IF (STATUS-1) 215,950,990
215     VALUE1=VALUE
C
C   PAUSE FOR 1 SEC.
        CALL SLEEP$(MSEC)
C
        CALL POSIT(MOT,VALUE,STATUS)
        IF (STATUS-1) 225,950,990
225     IF(VALUE .NE. VALUE1)GO TO 210
        IF(POS .GT. VALUE)DIF=POS-VALUE
        IF(POS .LE. VALUE)DIF=VALUE-POS
        IF(DIF .LE. TOL)GO TO 999
        GO TO 30
C
C SOMEONE PROBABLY SWITCHED FROM REMOTE TO LOCAL IN THE
C MIDDLE OF MOVING TO THE TARGET LOCATION. SHAME ON THEM!
C
950     CONTINUE
        IER=1
        GO TO 999
C
C ERROR ON GPIB
C
990     CONTINUE
        IER=2
C
999     RETURN
        END
```

```
C   MOVTAP: VERIFY AND MOVE TAPE
C
C     ****************************************************************
C     *                                                              *
C     *           REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C     *           VERSION 1.0    JUNE 1,1980                         *
C     *           BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C     *                                                              *
C     ****************************************************************
C
C     *CALLED BY: RVIMG AND RVINSP                                   *
C     *FUNCTION:  1. IF A NEW TAPE, MAKE SURE ON-LINE, AND   REWIND  *
C     *           2. MOVE THE TAPE TO THE CORRECT POSITION           *
C
        SUBROUTINE MOVTAP(NEW,NFIL,IERR)
C
C   NEW  = FLAG FOR NEW MOUNT OR ALREADY INSTALLED
C   NFIL = FILE NUMBER TO POSITION TAPE
C   IERR = ERROR RETURNED
C
$INSERT TCOM
$INSERT SYSCOM>A$KEYS
C
        LOGICAL NEW
        INTEGER STATUS(3),STAT1,STAT2,UPDN,STATR(3),STATR1

        EQUIVALENCE (STATUS(1),STAT1), (STATUS(2),STAT2)
        EQUIVALENCE (STATR,START1)
C
C
C       TRACE N,NFIL,UPDN,TFCNT   /* ***CHECKOUT***
C       NFIL = NFIL
C
        UPDN = 1
        MOVE = :22200   /* MOVE FORWARD ONE FILE
        IF (.NOT. NEW) GOTO 40
C
C  NEW TAPE, VERIFY THAT TAPE UNIT IS SET UP
C
C  CHECK THE TAPE FOR ONLINE
C----------------------------
20      TFCNT = 1        /* PRESENT FILE NO.
        CALL T$MT(0,LOC(TREC),0,:100000,STATUS)
C       CALL MSDUMP('SELECT',6,STATUS)  /****CHECKOUT
        IF (AND(:300,STAT2) .NE. :300) GOTO 9200
C
C REWIND TAPE
C-----------
30      CALL T$MT(0,LOC(TREC),0,:40,STATR)
C       CALL MSDUMP('REWIND',6,STATR)  /****CHECKOUT
32      IF(AND(STATR1,1) .EQ. 0) GOTO 35
        CALL T$MT(0,LOC(TREC),0,:100000,STATUS)
        GOTO 32
35      N = NFIL - TFCNT
        GO TO 70
C
C  TAPE ALREADY INSTALLED POSITION IT
C------------------------------------
40      N = NFIL - TFCNT
        IF (N .GE. 1) GOTO 70
        UPDN = -1
        MOVE = :20100   /* BACKWARD ONE FILE
        N = -N
C
C
C  MOVE TO CORRECT PLACE ON TAPE
C-------------------------------
70      IF (N .EQ. 0) RETURN
        CALL T$MT(0,LOC(TREC),0,MOVE,STATUS)  /*MOVE TAPE 1 FILE
        IF (STAT1 .EQ. 0) GOTO 90
80      CALL T$MT(0,LOC(TREC),0,:100000,STATUS)
        IF (STAT1 .NE. 0) GOTO 80
90      N = N - 1
        TFCNT = TFCNT + UPDN
        GOTO 70
```

```
C
C RECORD NOT FOUND
C
9200    WRITE(1,9210)
9210    FORMAT(1X,'PLEASE MOUNT TAPE AND PUT ONLINE')
        DO 9211 I = 1,3
        CALL TOOCT(STATUS(I))
9211    CALL TNOUA(' ',1)
        CALL PAUS(J)
        GOTO 20
        END
```

```
C PIMG:PROCESS THE IMAGE
C
C     ***************************************************************
C     *                                                             *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C     *          VERSION 1.0     JUNE 1,1980                        *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C     *                                                             *
C     ***************************************************************
C
C     *CALLED BY: DINSP                                             *
C     *FUNCTION:  1. INITIALIZE IMAGE DIRECTORY (CLEAN)             *
C     *           2. SET IMAGE PROCESSOR TO FREERUN                 *
C     *           3. ALLOW OPERATOR TO ADJUST MOTORS,CAMERA         *
C     *           4. DO EACH IMAGE PROCESSING REQUEST (CMDM70)      *
C     *           5. IF CODE = 0: DO NEXT PROCESS IMMEDIATELY       *
C     *                        1: WAIT FOR OPERATOR                 *
C     *                        2: WRITE IMAGE TO TAPE               *
C     *                        3: LET OPERATOR POSITION MOTOR,      *
C     *                           THEN TELL HIM MOTOR POSITION      *
C
      SUBROUTINE PIMG(ITEST,NOTAPE,IERR)
C
C  ITEST  = TEST SEQUENCE NO
C  NOTAPE = FLAG FOR NOTAPE
C  IERR   = ERROR CODE RETURNED
C
      INTEGER S500N(8),ISTAT(2),DIGIT(40),COMND,DIRCK(40)
      LOGICAL MORE
C
$INSERT PTCOM
$INSERT RTCOM
$INSERT TCOM
$INSERT CCOM
$INSERT SYSCOM>PARM.K
C
      LOGICAL NOTAPE
      DATA DIGIT/'>DIGITIZE>$A; ',33*'  '/
      DATA DIRCK/'>DIRCK; ',36*'  '/
C
C
C   CLEAN THE IMAGE DIRECTORY
C---------------------------
      CALL CLEAN
C
C   SET IMAGE PROCESSOR TO FREERUN AND GIVE OPERATOR A CHANCE TO FINE
C   TUNE THE MOTORS AND CAMERA
C-----------------------------------------------------------------------
      CALL CMDM70(DIGIT,IERR)
      WRITE(1,5)
5     FORMAT(1X,'ADJUST MOTORS AND CAMERA AS NECESSARY - HIT A KEY WHEN
     1 READY',//)
      CALL PAUS(J)
C
C   DO EACH IMAGE REQUEST
C----------------------
      IBIAS = 177
      DO 100 I = 1,PNIMG
         COMND = PTREC(IBIAS)
         IF (COMND .EQ. 0) RETURN
         IF (COMND .EQ. '  ') GOTO 8
         IFLAG=FL$RET
6        CALL NEXT$(CCHN,CREC,PTREC(IBIAS),CARR,IFLAG,$9000,0,0,0,0)
         DO 7 J = 1,CNPROC
            JBIAS = 11 + (J-1)*CNWI
            ICMND = CREC(JBIAS)
            IF (ICMND .EQ. 0) GOTO 7
            IF (ICMND .EQ. '  ') GOTO 7
            CALL CMDM70(CREC(JBIAS),IERR)
7         CONTINUE
8        NEXT = IBIAS + 40
         IBIAS = IBIAS + PNWI
         MOVE = PTREC(NEXT)
         IF (MOVE .LE. 0) GOTO 100
         IF (MOVE .GT. 4) GOTO 98
```

```
C
          GOTO (10,20,30,40), MOVE
C
10        CALL PAUS(J)
          GOTO 100
C
C SAVE IMAGE ON TAPE
20        IF (NOTAPE) GOTO 100
          CALL ZMVD(RTTNM,S500N,16)
          CALL SVIMT(S500N)
C
C CREATE THE TAPE ID RECORD
          CALL SVTAPR(IERR)
          GOTO 100
C
C ALLOW OPERATOR TO POSITION MOTOR, THEN TELL HIM WHERE HE'S AT
30      CALL PAUS(J)
        CALL POSIT(2,IVAL,ISTAT)
        WRITE(1,1)IVAL
1       FORMAT(1X,'CURRENT POSITION IS ',I5)
        CALL DMORE(MORE)
        IF (MORE) GOTO 30
        GOTO 100
C
C DIRCK
C
40      CALL CMDM70(DIRCK,IERR)
        CALL TNOUA(PTREC(IBIAS),40)
        CALL PAUS(J)
        GOTO 100
C
C ERROR OCCURRED
C
98        WRITE (1,99) MOVE,I
99        FORMAT('**ERROR** PLANNED NEXT MOVE =',I3,' TEST',I3)
C
100     CONTINUE
C
C SET IMAGE PROCESSOR TO FREERUN
        CALL CMDM70(DIGIT,IERR)
C
        RETURN
C
C MIDAS ERROR IN FINDING COMMAND FILE
C
9000    IERR = CERR
        IF(CERR.NE.22 .OR. CERR .NE. 24) GOTO 9900
        CALL RECYCL
        GO TO 6              /* TRY AGAIN
9900    IF (CERR .NE. 7) GOTO 9905
        JBIAS=IBIAS+9
        WRITE(1,9901)(PTREC(I),I=IBIAS,JBIAS),CNNAM
9901    FORMAT(1X,'TEST ',10A2,' NOT FOUND IN DATA BASE ',16A2)
        CALL TDUMP(PTREC(IBIAS),20)
        RETURN
9905    JBIAS = IBIAS + 9
        WRITE(1,9910)CERR,(PTREC(I), I=IBIAS,JBIAS),CCNAM
9910    FORMAT(1X,'MIDAS ERROR ',I3,' IN TEST ',16A2/1X,
     C'FROM DATA BASE ',16A2)
        RETURN
        END
```

```
C  PLAN: MAIN PLANNING ROUTINE
C
C     ****************************************************************
C     *                                                              *
C     *         REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM         *
C     *         VERSION 1.0     JUNE 1,1980                          *
C     *         BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY        *
C     *                                                              *
C     ****************************************************************
C
C     *CALLED FROM: AI                                               *
C     *FUNCTION: 1. GET PLANNING FUNCTION DESIRED (GPFNCT)           *
C     *          2. CALL ONE OF FOLLOWING SUBROUTINES:               *
C     *             CNEWP - CREATE A NEW PLAN                        *
C     *             CNEWT - CREATE A NEW TEST PLAN                   *
C     *             MKFMP - MAKE A NEW PLANFROM AN OLD ONE           *
C     *             MKFMT - MAKE A NEW TEST PLAN FROM AN OLD ONE     *
C     *             MDFYP - MODIFY A PLAN                            *
C     *             MDFYT - MODIFY A TEST PLAN                       *
C     *             DLTP  - DELETE A PLAN                            *
C     *             DLTT  - DELETE A TEST PLAN                       *
C     *             DLTR  - DELETE A RESULT                          *
C     *             DSPLD - DISPLAY DATA                             *
C     *             CNEWC - CREATE A NEW COMMAND FILE                *
C     *             MDFYC - MODIFY A COMMAND FILE                    *
C     *             DLTC  - DELETE A COMMAND FILE                    *
C
      SUBROUTINE PLAN(IER)
C
      IER = 0
5     CALL GPFNCT(MENU)
      IF (MENU .LE. 0) RETURN
C
      GOTO (
     1 100,200,300,400,500,600,700,800,900,
     2 1000,1100,1200,1300,1400
     3 ), MENU
      GOTO 5
C
C   CREATE NEW PLAN
100   CALL CNEWP(IER)
      IF (IER) 9000,5,9000
C
C   CREATE NEW TEST PROC.
200   CALL CNEWT(IER)
      IF (IER) 9000,5,9000
C
C   ADD A COMMAND FILE
300   CALL CNEWC(IER)
      IF (IER) 9000,5,9000
C
C   MAKE NEW PLAN FROM OLD
400   CALL MKFMP(IER)
      IF (IER) 9000,5,9000
C
C   MAKE NEW TEST PROC FROM OLD
500   CALL MKFMT(IER)
      IF (IER) 9000,5,9000
C
C   MAKE A NEW COMMAND FROM OLD
600   CALL MKFMC(IER)
      IF (IER) 9000,5,9000
C
C   MODIFY PLAN
700   CALL MDFYP(IER)
      IF (IER) 9000,5,9000
C
C   MODIFY TEST PROC
800   CALL MDFYT(IER)
      IF (IER) 9000,5,9000
C
C   MODIFY A COMMAND FILE
900   CALL MDFYC(IER)
      IF (IER) 9000,5,9000
C
```

```
C     DELETE A PLAN
1000     CALL DLTP(IER)
         IF (IER) 9000,5,9000
C
C     DELETE A TEST PROC.
1100     CALL DLTT(IER)
         IF (IER) 9000,5,9000
C
C     DELETE RESULTS
1200     CALL DLTR(IER)
         IF (IER) 9000,5,9000
C
C     DELETE A COMMAND FILE
1300     CALL DLTC(IER)
         IF (IER) 9000,5,9000
C
C     DISPLAY FUNCTIONS
1400     CALL DSPLD(IER)
         IF (IER) 9000,5,9000
C
C
9000     RETURN
         END
```

```
C PMOT: POSITION MOTORS
C
C     ****************************************************************
C     *                                                              *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C     *          VERSION 1.0    JUNE 1,1980                          *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C     *                                                              *
C     ****************************************************************
C
C     *CALLED BY: DINSP                                              *
C     *FUNCTION: 1. POSITION A MOTOR (MOTOR)                         *
C     *          2. IF MOTOR CONTROL PUT TO MANUAL DURING            *
C     *             POSITIONING, PAUSES UNTIL IN REMOTE              *
C
      SUBROUTINE PMOT
C
$INSERT PTCOM
C
C TURN ON MOTORS WHICH ARE TO RUN CONTINUOUSLY DURING POSITIONING
C
      IPOS = 167
      NDIR = 1
      DO 5 I = 1,PNMOT
         NSPEED = PTREC(IPOS+1)
         NPOS = PTREC(IPOS)
         IF (NPOS .NE. -1) GOTO 7
         M = I - 1
         CALL MOTION(M,NDIR,NSPEED,IERR)
         IF (IERR .NE. 0) GOTO 30
7        IPOS = IPOS + PNWM
5     CONTINUE
C
C POSITION MOTORS WHICH HAVE ENCODERS
C
      IPOS = 167
      DO 20 I = 1,PNMOT
         NSPEED = PTREC(IPOS+1)
         IF (NSPEED .EQ. 0) GOTO 10
         NPOS = PTREC(IPOS)
         IF (NPOS .LE. 0) GOTO 10
         M = I - 1
8        CALL MOTOR(M,NSPEED,NPOS,IERR)
         IF (IERR .NE. 0) GOTO 30
10       IPOS = IPOS + PNWM
20    CONTINUE
C
C TURN OFF MOTORS WHICH WERE RUNNING CONTINUOUSLY DURING POSITIONING
C
      IPOS = 167
      DO 25 I = 1,PNMOT
         NSPEED = PTREC(IPOS+1)
         NPOS = PTREC(IPOS)
         IF (NPOS .NE. -1) GOTO 27
         M = I - 1
         CALL MOTION(M,NDIR,0,IERR)
         IF (IERR .NE. 0) GOTO 30
27       IPOS = IPOS + PNWM
25    CONTINUE
      RETURN
C
30    IF (IERR .NE. 1) GOTO 60
      CALL TNOUA('PUT MOTOR CONTROL IN REMOTE, HIT ANY KEY ',41)
      CALL PAUS(J)
      GOTO 8
C
60    WRITE(1,61)M,NSPEED,IERR
61    FORMAT(1X,'MOTOR # ',I3,' SPEED ',I3,' ERROR ',I3)
      RETURN
      END
```

```
C POSINT:  POSITION MOTOR & INITIALIZE ENCODER
C
C     *************************************************************
C     *                                                           *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM     *
C     *          VERSION 1.0     JUNE 1,1980                      *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY    *
C     *                                                           *
C     *************************************************************
C
C     *CALLED BY: INTMOT                                          *
C     *FUNCTION: 1.  POSITION THE MOTOR TO '0'  POSITION          *
C     *          2.  SET THE ENCODER COUNT TO '0'                 *
C
      SUBROUTINE POSINT(ENCDR,IER)
C             ENCDR  = THE ENCODER NUMBER TO INITIALIZE
C
C             IER    = THE ERROR FLAG (0 IF GOOD, 1 IF GPIOB ERROR)
C
C   NUMBER OF MILLISECONDS PAUSE TO WAIT FOR GEAR BACKLASH
      INTEGER*4 MSEC
      PARAMETER MSEC=1000
C
      INTEGER ENCDR,ENC
      INTEGER DIR(10),SPEED,VALUE,VALUE1
      DATA DIR / 0,0,1,0,0,0,0,0,0,0 /
      IER=0
C
C MOVE THE MOTOR IN THE DIRECTION SPECIFIED
C
10    CALL MOTION(ENCDR,DIR(ENCDR+1),127,IER)
        IF (IER-1) 20,15,200
15      CALL TNOUA('PUT MOTOR CONTROL IN REMOTE, HIT ANY KEY ',41)
        CALL PAUS(IGO)
        GOTO 10
C
C CHECK TO SEE IF THE ENCODER IS STILL CHANGING
C
20    CALL POSIT(ENCDR,VALUE1,IER)
         IF (IER-1) 30,25,200
25         CALL TNOUA('PUT MOTOR CONTROL IN REMOTE, HIT ANY KEY ',41)
           CALL PAUS(IGO)
           GOTO 20
30       CALL SLEEP$(MSEC)
         CALL POSIT(ENCDR,VALUE,IER)
         IF(VALUE1-VALUE .EQ. 0)GO TO 50
      GO TO 20
C
C STOP THE MOTOR
C
50    CALL MOTION(ENCDR,DIR(ENCDR),0,IER)
C
C CLEAR THE ENCDR
C
      ENC=OR(ENCDR,:100000)
      CALL POSIT(ENC,VALUE,IER)
      CALL POSIT(ENCDR,VALUE,IER)
C
C SET ERROR FLAG (FOR ENCODER NOT CLEARING)
C
      IF (VALUE .NE. -1) IER = 1
C
200   RETURN
      END
```

```
C RETR: RETRIEVE HISTORICAL RECORD
C
C     ***************************************************************
C     *                                                             *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C     *          VERSION 1.0    JUNE 1,1980                         *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C     *                                                             *
C     ***************************************************************
C
C     *CALLED BY: AI                                               *
C     *FUNCTION : 1. GET RETRIEVAL FUNCTION                        *
C     *           2. INITIALIZE THE IMAGE PROCESSOR (INTIP)        *
C     *           3. CALL ONE OF THE FOLLOWING SUBROUTINES:        *
C     *              RVIMG - GET ONE IMAGE                         *
C     *              RVTST - RECREATE ONE TEST                     *
C     *              RVINSP- RECREATE AN INSPECTION                *
C     *              DSPR  - DISPLAY MAIN RESULTS                  *
C     *              DSPRT - DISPLAT TEST RESULTS                  *
C     *              DSPT  - DISPLAY TAPE RECORD                   *
C     *              LISTIX- LIST DATA BASE BY INDEX#              *
C
C ARG 1: IERR  INTEGER
C
      SUBROUTINE RETR(EQUIP,IERR)
C
      INTEGER SPCHN,DIRCK(40)
      LOGICAL EQUIP
      DATA DIRCK/'>DIRCK ;',36*'  '/
C
C  SET SPOOL CHAN = 0 FOR DISPLAY ONLY
C
      SPCHN = 0
C
C GET RETRIEVAL FUNCTION
C
10    CALL GRFNCT(MENU)
      IF (MENU .EQ. 0) RETURN
      IF (MENU .GT. 3) GOTO 20
      IF (EQUIP) GOTO 20
C
C  INITIALIZE THE IMAGE PROCESSOR
C
      CALL INTIP(IERR)
      IF (IERR .EQ. 0) GOTO 20
      WRITE(1,15)IERR
15    FORMAT(1X,'ERROR ' I3,' IN INITIALIZING IMAGE PROCESSOR')
      RETURN
C
20    GOTO (100,200,300,400,500,600,700), MENU
C
C RETRIEVE IMAGE FOR DISPLAY
C
100   CALL RVIMG
      GOTO 10
C
C RECREATE ONE TEST RESULT
C
200   CALL RVTST
      GOTO    10
C
C RECREATE AN INSPECTION
C
300   CALL RVINSP
      GOTO 10
C
C DISPLAY MAIN RESULTS
C
400   CALL DSPR(SPCHN)
      GOTO 10
C
C DISPLAY TEST RESULTS
C
500   CALL DSPRT(SPCHN)
      GOTO 10
```

```
C
C DISPLAY TAPE RECORD
C
600     CALL DSPT(SPCHN)
        GOTO 10
C
C LIST INDEX
C
700     CALL LISTIX(SPCHN)
        GOTO 10
C
        END
```



```
C     RMNAB: REMOVE NON-ALPHABETICAL CHARACTERS
C
C     ****************************************************************
C     *                                                              *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C     *          VERSION 1.0     JUNE 1,1980                         *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C     *                                                              *
C     ****************************************************************
C
C     *GENERAL PURPOSE SUBROUTINE TO REMOVE NON-ALPHABETICAL         *
C     *CHARACTERS FROM A STRING                                      *
C
        SUBROUTINE RMNAB(IBUF,NCHAR)

C   IBUF       = TEXT STRING
C   NCHAR      = NO. CHARS IN TEXT, MAX = 80 CHARS.

$INSERT SYSCOM>A$KEYS
$INSERT SYSCOM>KEYS.F

        INTEGER JBUF(40)

C   INITIALIZE PARAMETERS
        K = 0
        N = NCHAR
        CALL ZFIL(JBUF,80,'  ')
        IF (N .GT. 80) N = 80

C   PACK INTO TEMP BUFFER
        DO 100 I=1,N
        IC = RS(GCHR$A(IBUF,I),8)
        IF (IC .LT. :260 .OR. IC .GT. :332) GOTO 100
        IF (IC .GT. :271 .AND. IC. LT. :301) GOTO 100
        K = K + 1
        CALL MCHR$A(JBUF,K,IC,2)
100     CONTINUE

C   NOW REPLACE THE ORIGINAL STRING WITH THE PACKED STRING
        CALL MSTR$A(JBUF,N,IBUF,N)
        RETURN
        END
```

```
C RVIMG: RETRIEVE AN IMAGE
C
C     ****************************************************************
C     *                                                              *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C     *          VERSION 1.0     JUNE 1,1980                         *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C     *                                                              *
C     ****************************************************************
C
C     *CALLED BY: RETR                                               *
C     *FUNCTION :1. GET TAPE NAME, IMAGE NAME, FILE# FROM OPERATOR   *
C     *          2. FIND THE RECORD IN THE TAPE DATA BASE            *
C     *          3. IS CORRECT TAPE MOUNTED?                         *
C     *          4. POSITION TAPE TO CORRECT FILE (MOVTAP)           *
C     *          5. WRITE IMAGE TO IMAGE PROCESSOR (CMDM70)          *
C
      SUBROUTINE RVIMG
C
$INSERT TCOM
$INSERT SYSCOM>A$KEYS
$INSERT SYSCOM>PARM.K
C
      LOGICAL ZCM,NEW,MORE
      INTEGER IBUF(36),TAPE(10),IMAGE(25),FILE,ENTER(40),SELECT(40)
C
      EQUIVALENCE (IBUF,TAPE)          /*TAPE NAME FROM PEDIT
      EQUIVALENCE (IBUF(11),IMAGE)     /*IMAGE NAME FROM PEDIT
      EQUIVALENCE (IBUF(36),FILE)      /*FILE NO FROM PEDIT
C
      DATA ENTER/'>ENTER>$A;',35*'  '/
      DATA SELECT/'$A>SELECT;',35*'  '/
C
C OPEN SCREEN TEMPLATE
C
      CALL VOPEN$('DEMO.SCREEN.FT',14,1,ICH,IERR)
      IF (IERR .NE. 0) GOTO 9000
C
C GET TAPE NAME,IMAGE NAME,OR FILE NO
C
      CALL ZFIL(IBUF,72,0)
      IS = 200
      IE = 204
      NEWSCR = 2      /* DO NOT ERASE SCREEN TO START
3     CALL PEDIT(ICH,IBUF,IS,IE,NEWSCR)
      FILE = FILE     /***CHECKOUT
C
C GET RECORD BASED ON PEDIT INFO
C
      IF (TAPE(1) .EQ. 0) GOTO 120
      NEW = .NOT.ZCM(TAPE,20,TNAM,20,ICODE)
      IF (.NOT. NEW) GOTO 120
C
C FIND TAPENAME REQUESTED IN MIDAS
      IFLAG = FL$RET
      CALL NEXT$(TCHN,TREC,TAPE,TPARR,IFLAG,$100,0,0,0,0)
C
C NO FILE NUMBER SPECIFIED: FIND CORRECT IMAGE BY IMAGE NAME
      IF (FILE) 130,5,50
5     DO 10 N = 1,TNFL
         IBIAS = 12 + (N-1)*TNWT
         IF (ZCM(IMAGE,50,TREC(IBIAS),50,ICODE)) GOTO 50
10    CONTINUE
C
C CORRECT IMAGE NOT FOUND
C
      CALL ZFIL(TREC,TSZB,0)
20    WRITE(1,30)IMAGE
30    FORMAT(1X,'IMAGE ',25A2,' NOT FOUND.')
      GOTO 500
C
C FILE NUMBER SPECIFIED: FIND CORRECT IMAGE BY FILE NUMBER
C FILE NUMBER FOUND: READ TAPE TO IMAGE DIRECTORY AND IMAGE PROCESSOR
C
50    WRITE(1,60)TNAM
```

```
60      FORMAT('MOUNT TAPE: ' ,10A2,'& HIT ANY KEY WHEN READY')
        CALL PAUS(J)
70      CALL MOVTAP(NEW,FILE,IERR)
        IF (IERR .NE. 0) GOTO 9100
        CALL CLEAN
        CALL DIRCK      /****CHECKOUT
        CALL CMDM70(ENTER,IERR)
        CALL CMDM70(SELECT,IERR)
        CALL DIRCK      /****CHECKOUT
        TFCNT = TFCNT + 1
        GOTO 500
C
C TAPE RECORD NOT FOUND
C
100     WRITE(1,110)TAPE
110     FORMAT(1X,'TAPE RECORD ',10A2,' NOT FOUND')
        GOTO 500
C
C TAPE IS CURRENT ONE: WHAT IS FILE#?
C
120     IF (FILE) 130,150,70
C
C FILE# LESS THAN ZERO - GIVE 'EM ANOTHER CHANCE
C
130     CALL TNOU('PLEASE GIVE MORE SPECIFIC DATA',29)
135     CALL PAUS(J)
        GOTO 3
C FILE# NOT SPECIFIED: FIND IMAGE BY IMAGE NAME
C
150     DO 160 N = 1,TNFL
        IBIAS = 12 + (N-1)*TNWT
           IF (ZCM(IMAGE,50,TREC(IBIAS),50,ICODE)) GOTO 70
160     CONTINUE
        GOTO 20
C
C  MORE?
C
500     CALL DMORE(MORE)
        IF (MORE) GOTO 3
C
C CLOSE SCREEN TEMPLATE
C
600     CALL CLOS$A(ICH)
        RETURN
C
C
9000    WRITE(1,9010)IERR
9010    FORMAT(1X,'ERROR ',I3,' IN OPENING DEMO.SCREEN.FT')
        RETURN
C
9100    WRITE (1,9101) FILE,IERR
9101    FORMAT('ERROR IN LOCATING FILE',I3,' ERROR =',I3)
        GOTO 600
C
        END
```

```
C RVINSP: RECREATE AN INSPECTION
C
C     ****************************************************************
C     *                                                              *
C     *            REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM      *
C     *            VERSION 1.0     JUNE 1,1980                       *
C     *            BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY     *
C     *                                                              *
C     ****************************************************************
C
C     *CALLED BY: RETR                                                *
C     *FUNCTION:  1. GET PART#,INSP NAME, SERIAL# FROM OPERATOR       *
C     *           2. FIND CORRECT MATCH IN RESULTS DATA BASE          *
C     *           3. OPERATOR: MOUNT CORRECT TAPE                     *
C     *           4. POSITION TAPE TO FIRST INSPECTION                *
C     *           5. OUTPUT IMAGE, PROCESS IMAGE AS WAS DONE ORIGINALLY*
C     *           6. REPEAT FOR EACH TEST                             *
C
      SUBROUTINE RVINSP
C
      WRITE(1,1)
1     FORMAT('*** NOT IMPLEMENTED ***',/,'    DO ONE TEST AT A TIME.')
      RETURN
      END
```

```
C RVTST: RECREATE ONE TEST RESULT
C
C     ***************************************************************
C     *                                                             *
C     *           REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM      *
C     *           VERSION 1.0    JUNE 1,1980                        *
C     *           BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY     *
C     *                                                             *
C     ***************************************************************
C
C     *CALLED BY: RETR                                              *
C     *FUNCTION : 1. GET PART#, INSP NAME, SERIAL#, TESTNAME (PEDIT) *
C     *           2. CREATE KEYWORD (CRPKEY)                        *
C     *           3. FIND TEST RESULT RECORD IN DATA BASE           *
C     *           4. CORRECT TAPE MOUNTED?                          *
C     *           5. POSITION TAPE (MOVTAP)                         *
C     *           6. DISPLAY TEST RESULT RECORD ON SCREEN (RPTGEN)  *
C     *           7. OUTPUT IMAGE TO IMAGE PROCESSOR                *
C     *           8. PROCESS IMAGE AS WAS DONE ORIGINALLY           *
C
      SUBROUTINE RVTST
C
$INSERT RTCOM
$INSERT TCOM
$INSERT CCOM
$INSERT SYSCOM>PARM.K
$INSERT SYSCOM>A$KEYS
C
      INTEGER IID(5),PART(10),IN(10),SNO(10),TN(10),IBUF(45),RKEY(20)
      INTEGER ENTER(40),SELECT(40)
      LOGICAL NEW,MORE,YSNO$A,ZCM
      EQUIVALENCE (IBUF,IID)
      EQUIVALENCE (IBUF(6),PART)
      EQUIVALENCE (IBUF(16),IN)
      EQUIVALENCE (IBUF(26),SNO)
      EQUIVALENCE (IBUF(36),TN)
C
      DATA ENTER/'>ENTER>$A;',35*'  '/
      DATA SELECT/'$A>SELECT;',35*'  '/
C
C OPEN SCREEN TEMPLATE
C
      CALL VOPEN$('DEMO.SCREEN.FT',14,1,IPCH,IERR)
      IF (IERR .NE. 0) GOTO 9000
C
C GET PART#,INSP NAME,SERIAL#,TEST NAME
C
      CALL ZFIL(IBUF,90,0)
      IS = 0
      IE = 6
      NEWSCR = 2       /*DO NOT ERASE SCREEN TO START
      CALL PEDIT(IPCH,IBUF,IS,IE,NEWSCR)
C
C CREATE RTCOM KEYNAME,FIND ITS LENGTH
C
      CALL CRPKEY(PART,20,IN,20,SNO,20,TN,20,RKEY,40)
      NCHAR = LSIZE(RKEY,40)
      IFLAG = FL$RET + FL$BIT
C     CALL TNOU(RKEY,40)
C     CALL TDUMP(RKEY,40)
C
C FIND THE RECORD FOR RTCOM
C
      CALL ZFIL(RTREC,RTSZB,0)
10    CALL NEXT$(RTCHN,RTREC,RKEY,RTARR,IFLAG,$9100,0,0,0,NCHAR)
      IFLAG = FL$BIT + FL$RET + FL$USE
      IF (RTTNM(1) .EQ. 0) GOTO 10
C
C   CHANGE PASS/FAIL CODE TO ASCII
C
      RTPF = RTPF + :260
C
C IS CORRECT TAPE MOUNTED?
C
      NEW = .FALSE.
```

```
      IF (TNAM(1) .EQ. 0) GOTO 15
      IF (ZCM(RTTNM,20,TNAM,20,ICODE)) GOTO 40
15    NEW = .TRUE.
      CALL ZFIL(TREC,TSZB,0)
      IFLAG = FL$RET
      CALL NEXT$(TCHN,TREC,RTTNM,TPARR,IFLAG,$9200,0,0,0,0)
      WRITE(1,20)RTTNM
20    FORMAT('PLEASE MOUNT TAPE: ',10A2,'& HIT ANY KEY WHEN READY')
      CALL PAUS(J)
C
40    CALL MOVTAP(NEW,RTFNM,IERR)
      IF (IERR .NE. 0) GOTO 9300
C
C READ IMAGE TO IMAGE PROCESSOR
C
      CALL CLEAN
      CALL CMDM70(ENTER,IERR)
      CALL CMDM70(SELECT,IERR)
      TFCNT = TFCNT + 1
C
C DISPLAY TEST NAME, DESCRIPTION,PASS/FAIL,COMMENTS,TAPENAME,FILE#,IMAGENAME
C
      IS = 304
      IE = 318
      NEWSCR = 2      /* DO NOT ERASE SCREEN TO START
      CALL RPTGEN(0,IPCH,RTREC,LINES,IS,IE,NEWSCR)
C
C FIND IMAGE COMMAND THAT CAUSES IMAGE TO BE WRITTEN TO TAPE
C
      NBIAS = 217
C
      DO 50 I = 1,8
         IMG = I
         NEXT = RTREC(NBIAS)
         IF (NEXT .EQ. 2) GOTO 60
         NBIAS = NBIAS + RNWI
50    CONTINUE
C
C RECREATE THE IMAGE PROCESSING
60    IBIAS = NBIAS + 1
C
      DO 70 I = IMG,8
         NBIAS = NBIAS + RNWI
         ICMD = RTREC(IBIAS)
         IF (ICMD .EQ. '  ') GOTO 66
         IF (ICMD .EQ. 0) GOTO 80
         IFLAG=FL$RET
62       CALL NEXT$(CCHN,CREC,RTREC(IBIAS),CARR,IFLAG,$9500,0,0,0,0)
         DO 64 J = 1,CNPROC
            JBIAS = 11 + (J-1)*CNWI
            PROC = CREC(JBIAS)
            IF (PROC .EQ. 0) GOTO 64
            IF (PROC .EQ. '  ') GOTO 64
            CALL CMDM70(CREC(JBIAS),IERR)
            IF (IERR .NE. 0) GOTO 9400
64       CONTINUE
         IF (RTREC(NBIAS) .EQ. 0) GOTO 66
         CALL PAUS(J)
66       IBIAS = NBIAS + 1
70    CONTINUE
C
C ANY MORE MATCHES?
C
80    IFLAG = FL$BIT + FL$RET + FL$USE
      MORE = YSNO$A('LOOK FOR MORE MATCHES',21,A$DNO)
      IF (MORE) GOTO 10
      GOTO 9900
C
C ERRORS
C
9000  WRITE(1,9010)IERR
9010  FORMAT(1X,'ERROR ',I3,' IN OPENING DEMO.SCREEN.FT')
      RETURN
C
9100  IF (RTERR .EQ. 7) GOTO 9900
```

```
      IF (RTERR .NE. 22 .AND. RTERR .NE. 24) GOTO 9110
      CALL RECYCL
      GOTO 10
9110  WRITE(1,9120)RTERR,RKEY
9120  FORMAT(1X,'MIDAS ERROR ',I3,' IN FINDING ',20A2)
      GOTO 9900
C
9200  IF (TPERR .NE. 7) GOTO 9208
      WRITE(1,9201) RTTNM
9201  FORMAT('DATA BASE ERROR: TAPE ',10A2,' NOT FOUND.')
      GOTO 9900
9208  WRITE(1,9210)TPERR,RTTNM
9210  FORMAT(1X,'MIDAS ERROR ',I3,' IN FINDING TAPE ',10A2)
      CALL TDUMP(RTTNM,20)
      GOTO 9900
C
9300  WRITE(1,9310)IERR,RTTNM,RTFNM
9310  FORMAT(1X,'MOVTAP ERROR ',I3,' IN MOVING TAPE ',10A2,' TO FILE '
     C ,I3)
      GOTO 9900
C
9400  WRITE(1,9410)IERR,IBIAS
9410  FORMAT(1X,'CMDM70 ERROR ',I3,' IN IMAGE PROCESS ',I3)
      GOTO 9900
C
9500  IF (CERR .NE. 7) GOTO 9510
      JBIAS=IBIAS+9
      WRITE(1,9501)(RTREC(I),I=IBIAS,JBIAS),CNNAM
9501  FORMAT(1X,'TEST ',10A2,' NOT FOUND IN DATA BASE ',16A2)
CX    CALL TDUMP(RTREC(IBIAS),20)
      GOTO 9900
9510  IF(CERR .NE. 22 .OR. CERR .NE. 24) GOTO 9520
      CALL RECYCL
      GO TO 62             /* TRY AGAIN
9520  JBIAS = IBIAS + 9
      WRITE(1,9521)CERR,(RTREC(I),I=IBIAS,JBIAS),CCNAM
9521  FORMAT(1X,'MIDAS ERROR ',I3,' IN TEST ',16A2/1X,
     C'FROM DATA BASE ',16A2)
      GOTO 9900
C
C CLOSE SCREEN TEMPLATE
C
9900  CALL CLOS$A(IPCH)
      RETURN
      END
```

```
C SPOLIT: SPOOL RETRIEVAL INFORMATION
C
C     *************************************************************
C     *                                                           *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM     *
C     *          VERSION 1.0    JUNE 1,1980                       *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY    *
C     *                                                           *
C     *************************************************************
C
C     *CALLED BY: DSPLD                                           *
C     *FUNCTION : 1. CLOSE THE INTERMEDIATE SPOOL FILE            *
C     *           2. SPOOL THE FILE TO THE LINE PRINTER (SPOOL)   *
C     *           3. DELETE THE INTERMEDIATE SPOOL FILE           *
C
C ARG 1: SPCHN   INTEGER
C ARG 2: SPFNAM  STRING
C
      SUBROUTINE SPOLIT(SPCHN,SPFNAM)
C
$INSERT SYSCOM>A$KEYS
$INSERT SYSCOM>KEYS.F
$INSERT SYSCOM>PARM.K
C
      INTEGER ICHN(2),BSIZE,NSIZE
      PARAMETER BSIZE = 2000, NSIZE = 7
      PARAMETER NBTS = NSIZE*2
      INTEGER BUFFER(BSIZE),INFO(12),SPCHN,SPFNAM(NSIZE)
      LOGICAL DEL
C
C
C  GET 2 FREE CHANNELS FOR THE SPOOLER & LOAD INFO
C
      CALL FREECH(2,ICHN)
      INFO(1) = ICHN(1)
      INFO(2) = ICHN(2)
      INFO(3) = 0
      INFO(4) = '  '
      INFO(5) = '  '
      INFO(6) = '  '
      INFO(7) = 0
      INFO(11) = 0
C
C CLOSE SPOOLFILENAME FILE
C
      CALL CLOS$A(SPCHN)
      KEY = 1 /* COPY FILE INTO SPOOL QUEUE
C
C     /*****CHECKOUT
      IERR = IERR       /****CHECKOUT
      JSIZ=BSIZE
      WRITE(1,9000) SPCHN,KEY,SPFNAM,INFO,JSIZ,IERR
9000  FORMAT('SPOOL CHAN =',I3,/
     -   'KEY = ',I3,/
     -   'FILE NAME= ',7A2,/
     -   'INFO = ',3I4,3A2,I4,3A2,I4,I4,/
     -   'BUFFER ',I6,/
     -   'ERROR =',I3)
C
C SPOOL OUT THE HISTORY DATA
C
      CALL SPOOL$(KEY,SPFNAM,NBTS,INFO,BUFFER,BSIZE,IERR)
      IF (IERR .EQ. 0) GOTO 100
      WRITE(1,10)IERR,SPFNAM
10    FORMAT(1X,'ERROR ',I3,' IN SPOOLING ',7A2)
C
C DELETE SPFNAM
C
100   DEL = DELE$A(SPFNAM,14)
      IF(DEL) RETURN
      WRITE(1,150)IERR,SPFNAM
150   FORMAT(1X,'ERROR ',I3,' IN DELETING ',SPFNAM,7A2)
      RETURN
      END
```

C SVIMD: SAVE IMAGE ON DISK

```
C SVIMD: SAVE IMAGE ON DISK
C
C     ****************************************************************
C     *                                                              *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C     *          VERSION 1.0     JUNE 1,1980                         *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C     *                                                              *
C     ****************************************************************
C
C     *CALLED BY: SVRES                                              *
C     *FUNCTION:  SAVE THE IMAGE ON DISK                             *
C
        SUBROUTINE SVIMD(NAME)
C
        CALL TNOUA('SAVE IMAGE: ',12)
        CALL TNOUA(NAME,32)
        CALL TNOU (' NOT IMPLEMENTED!',17)
        RETURN
        END
```

C SVIMT: SAVE IMAGE ON TAPE

```
C SVIMT: SAVE IMAGE ON TAPE
C
C     ****************************************************************
C     *                                                              *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C     *          VERSION 1.0     JUNE 1,1980                         *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C     *                                                              *
C     ****************************************************************
C
C     *CALLED BY: PIMG                                               *
C     *FUNCTION: 1. ADD THIS IMAGE'S NAME TO THE TAPE RECORD         *
C     *          2. WRITE THE IMAGE TO TAPE (CMDM70)                 *
C
        SUBROUTINE SVIMT(S500N)
C
C  S500N  = SYSTEM 500 IMAGE NAME
C
$INSERT RTCOM
$INSERT TCOM
$INSERT SYSCOM>A$KEYS
        INTEGER LINE(40)
C
C MOVE IMAGE NAME TO TREC
        IBIAS = 12 + TNFL*TNWT
        NBYT = TNWT*2
        CALL ZMVD(RTIMN,TREC(IBIAS),NBYT)
        TNFL = TNFL + 1
        TFCNT = TFCNT + 1
C FORMAT A COMMAND LINE TO WRITE IMAGE TO TAPE
        CALL ZMV('$A>XFER;',8,LINE,80)
C       CALL ZMVD(S500N,LINE,16)
C       CALL PACK(LINE,80)
C WRITE TAPE USING THE S500 COMMAND LINE
        CALL CMDM70(LINE,IERR)
        RETURN
        END
```

```
C SVMRES: SAVE RESULTS - MAIN RECORD
C
C     ****************************************************************
C     *                                                              *
C     *           REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C     *           VERSION 1.0     JUNE 1,1980                        *
C     *           BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C     *                                                              *
C     ****************************************************************
C
C     *CALLED BY: DINSP                                              *
C     *FUNCTION: 1. CREATE MAIN RESULTS KEYWORD                      *
C     *           2. ADD MAIN REAULTS RECORD & TESTNAMES TO DATA BASE *
C
      SUBROUTINE SVMRES(IERR)
$INSERT RCOM
$INSERT PCOM
$INSERT SYSCOM>PARM.K
C
      INTEGER RKEY(20),BIAS
C
C
C
      CALL ZFIL(RKEY,40,'  ')
      CALL CRPKEY(RPN,20,RIN,20,RSNO,20,0,0,RKEY,40)       /*CR RES KEY
      CALL APDAT(RKEY,40)      /*APPEND DATE
C
C ADD MAIN RESULT FILE TO DATA BASE
C
      CALL ADD1$(RLCHN,RREC,RKEY,RLARR,FL$RET,$9000,0,0,0,0)
C
C ADD TEST NAMES TO DATA BASE AS SECONDARD KEYNAMES
C
      DO 100 I = 1,PNT
         BIAS = 43 + (I-1)*RNWT        /* FIND TEST NAME
         CALL ADD1$(RLCHN,RKEY,RREC(BIAS),RLARR,FL$USE,$9050,1,0,0,0)
100   CONTINUE
      IERR = 0
      RETURN
C
C ERROR IN INSERTING MAIN RECORD
C
9000  IERR = RLERR
      WRITE(1,9010)IERR,RKEY
9010  FORMAT(1X,'MIDAS ERROR ',I2,' IN ADDING ',20A2,'TO RESULT DB')
      RETURN
C
C ERROR IN INSERTING A SECONDARY KEY
C
9050  WRITE(1,9060)IERR,RREC(BIAS),I
9060  FORMAT(1X,'MIDAS ERROR ',I2,' IN ADDING ',25A2,' INDEX: ',I2)
      RETURN
      END
```

```
C SVRES: SAVE RESULTS OF INSPECTION
C
C     ****************************************************************
C     *                                                              *
C     *           REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM       *
C     *           VERSION 1.0    JUNE 1,1980                         *
C     *           BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY      *
C     *                                                              *
C     ****************************************************************
C
C     *CALLED BY: DINSP                                              *
C     *FUNCTION:  1. GET PASS/FAIL CODE,COMMENTS ON TEST             *
C     *           2. OUTPUT TAPE NAME,FILE NUMBER, IMAGE NAME        *
C     *           3. SAVE THE TEST RESULTS (SVTSTR)                  *
C     *           4. SET IMAGE PROCESSOR TO FREERUN                  *
C
       SUBROUTINE SVRES(DEFAUL,NOTAPE,ILOOP,RTKEY,IERR)
C
$INSERT RTCOM
$INSERT RCOM
$INSERT SYSCOM>A$KEYS
C
       LOGICAL DEFAUL,NOTAPE
       INTEGER DIGIT(40)
       DATA DIGIT/'>DIGITIZE>$A; ',33*'  '/
C
       IF (.NOT.DEFAUL) GOTO 40
C
C DEFAULT PLAN - SAVE RESULTS? TAPE OR DISK?
C----------
5        WRITE(1,10)
10       FORMAT(/,'DEFAULT PLAN USED'/
     C1X,'0   DO NOT SAVE RESULTS'/
     11X,'1   SAVE RESULTS ON DISK'/
     21X,'2   SAVE RESULTS ON TAPE')
       READ(1,20,ERR=5)ISAVE
20     FORMAT(I1)
       IF (ISAVE .EQ. 0) GOTO 100
       GOTO (30,40),ISAVE
       GOTO 5
C
C DEFAULT PLAN - SAVE RESULTS ON DISC
C---------
30     CALL SVIMD(RTIMN)
       GOTO 100
C
C SAVE RESULTS ON TAPE
C----------
C OPEN SCREEN TEMPLATE
40     CALL VOPEN$('DEMO.SCREEN.FT',14,1,ICHN,IERR)
       IF (IERR .EQ. 0) GOTO 60
       WRITE(1,50)IERR
50     FORMAT(1X,'ERROR ',I2,' IN OPENING DEMO.SCREEN.FT')
       RETURN
C
C SET UP PEDIT PARAMETERS
C----------
60     IS = 25
       IE = 36
       NEWSCR = 2      /* DO NOT ERASE SCREEN TO START
       CALL PEDIT(ICHN,RTREC,IS,IE,NEWSCR)
C
C CLOSE SCREEN FILE
C----------
       CALL CLOS$A(ICHN)
C
C SAVE TEST RESULTS
C----------
       IF (DEFAUL) GOTO  100
       CALL SVTSTR(RTKEY,IERR)
C
C SET IMAGE PROCESSOR TO FREERUN
C----------
100    CALL CLEAN
       CALL CMDM70(DIGIT,IERR)
```

```
      RETURN
      END
```



```
C SVTSTR: SAVE TEST RESULTS
C
C    **************************************************************
C    *                                                            *
C    *        REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM        *
C    *        VERSION 1.0     JUNE 1,1980                         *
C    *        BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY       *
C    *                                                            *
C    **************************************************************
C
C    *CALLED BY: SVRES                                            *
C    *FUNCTION: SAVE TEST RESULTS TO DATA BASE                    *
C
      SUBROUTINE SVTSTR (KEY,IERR)
C
$INSERT RCOM
$INSERT RTCOM
$INSERT SYSCOM>PARM.K
C
      INTEGER KEY(25)
C
      IF (RTPF .EQ. 0) GOTO 10
      RPF = RTPF
C INSERT TEST RESULTS INTO DATA BASE
10    IFLAG = FL$RET
      CALL ADD1$(RTCHN,RTREC,KEY,RTARR,FL$RET,$9000,0,0,0,0)
      RETURN
9000  IERR = RTERR
      WRITE(1,9010)IERR,KEY
9010  FORMAT(1X,'MIDAS ERROR ',I2,', KEYWORD = ',25A2)
      RETURN
      END
```

```
C SVTAPR: SAVE THE TAPE RECORD (MIDAS)
C
C     ***************************************************************
C     *                                                             *
C     *            REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM     *
C     *            VERSION 1.0    JUNE 1,1980                       *
C     *            BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY    *
C     *                                                             *
C     ***************************************************************
C
C     *CALLED BY: PIMG                                              *
C     *FUNCTION:  ADD THE IMAGE NAME TO THE RECORD OF THIS TAPE     *
C
        SUBROUTINE SVTAPR(IERR)
C
$INSERT TCOM
$INSERT SYSCOM>PARM.K
        INTEGER TMPREC(TSZW)
C LOCK TAPE DATA BASE FOR EDITING
        IFLAGS =  FL$RET
10      CALL LOCK$(TCHN,TMPREC,TNAM,TPARR,IFLAGS,$9000,0,0,0,0)
C UPDATE TAPE DATA BASE RECORD
        IFLAGS = FL$USE
        CALL UPDAT$(TCHN,TREC,TNAM,TPARR,IFLAGS,$9050,0,0,0,0)
        IBIAS = 12 + (TNFL - 1)*TNWT
        CALL ADD1$(TCHN,TREC,TREC(IBIAS),TPARR,IFLAGS,$9200,1,0,0,0)
        IERR = 0
        RETURN
C ERROR FROM LOCK:IF BUSY, RECYCLE
9000    IF (TPERR .NE. 22 .AND .TPERR .NE. 24) GOTO 9100
        CALL RECYCL
        GOTO 10         /*BUSY - DIAL AGAIN
C WRONG NUMBER? - ERROR FROM LOCK$
9100    WRITE(1,9110)TPERR,TNAM
9110    FORMAT(1X,'MIDAS ERROR ',I2,'  FROM LOCK$, TNAM= ',10A2)
        IERR = TPERR
        RETURN
C ERROR IN UPDATING
9050    WRITE(1,9060)TPERR,TNAM
9060    FORMAT(1X,'MIDAS ERROR ',I2,' FROM LOCK$,TNAM = ',10A2)
        IERR = TPERR
        RETURN
9200    WRITE(1,9210)TPERR
9210    FORMAT(1X,'MIDAS ERROR ',I3,' IN ADDING IMAGE NAME')
        IERR = TPERR
        RETURN
        END
```

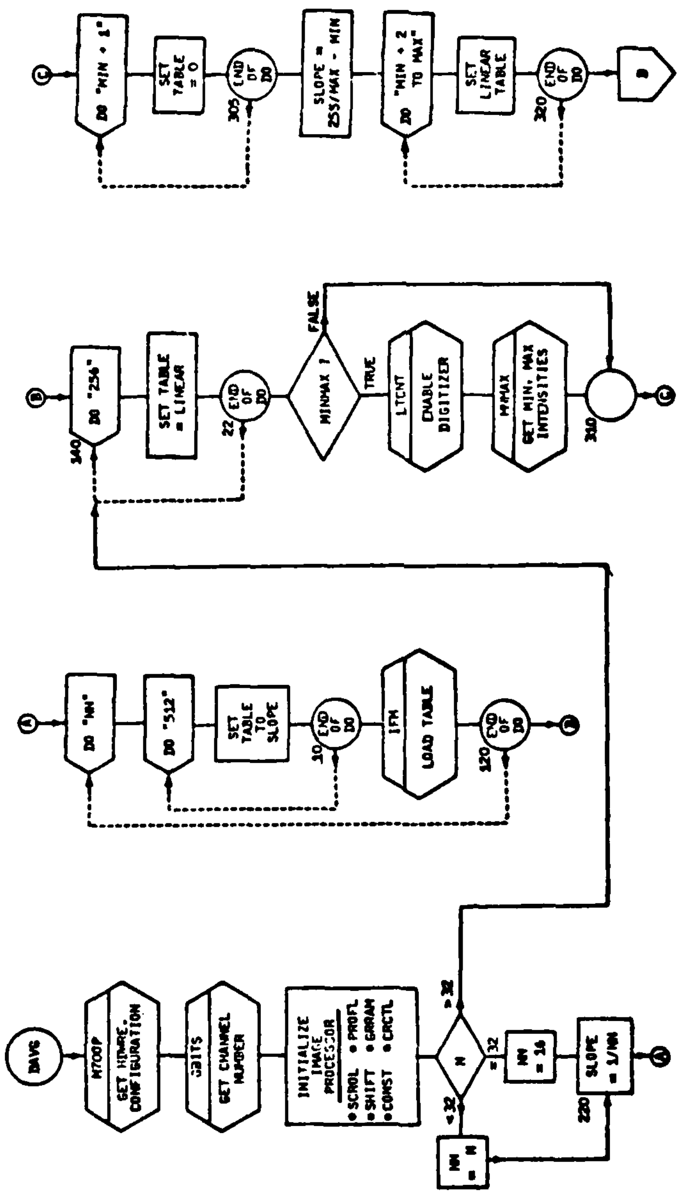
APPENDIX 6

STC SYSTEM 500 SOFTWARE ADDITIONS, LOGIC AND CODE

DAVG - PRIMITIVE FOR AVERAGING VIDEO FRAMES

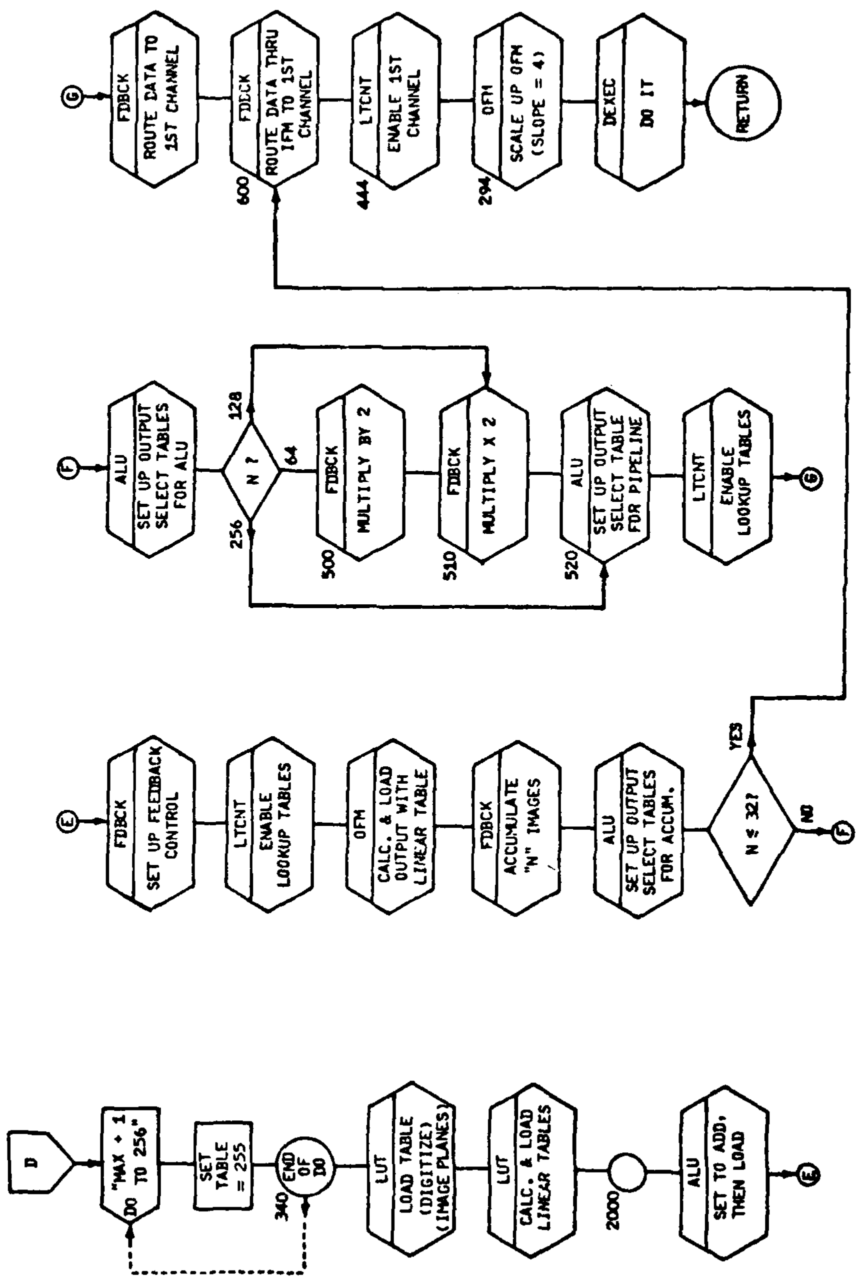
ARGUMENTS: 8

- INTEGER: FUNCTION CONTROL BLOCK
- INTEGER: BUFFER
- INTEGER: NO. OF FRAMES TO AVERAGE
- INTEGER: TIME TO DISPLAY IMAGE
- INTEGER: 1ST BREAKPOINT (MIN)
- INTEGER: 2ND BREAKPOINT (MAX)
- LOGICAL: KEYWORD (MINMAX)
- LOGICAL: BATCH



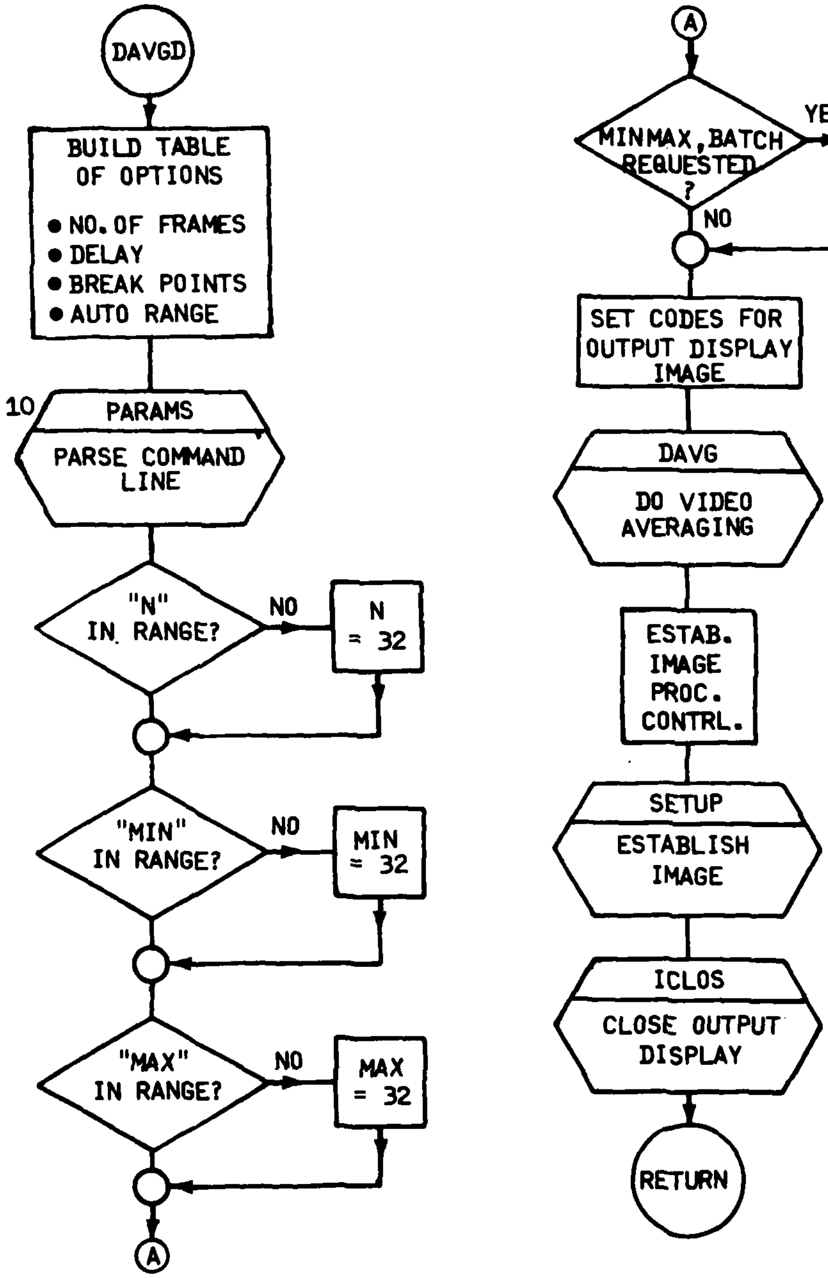
CONTINUED ON NEXT PAGE

DAVG - PRIMITIVE FOR AVERAGING VIDEO FRAMES (CONT'D)



DAVGD - INTERFACE TO PRIMITIVE FOR AVERAGING VIDEO FRAMES

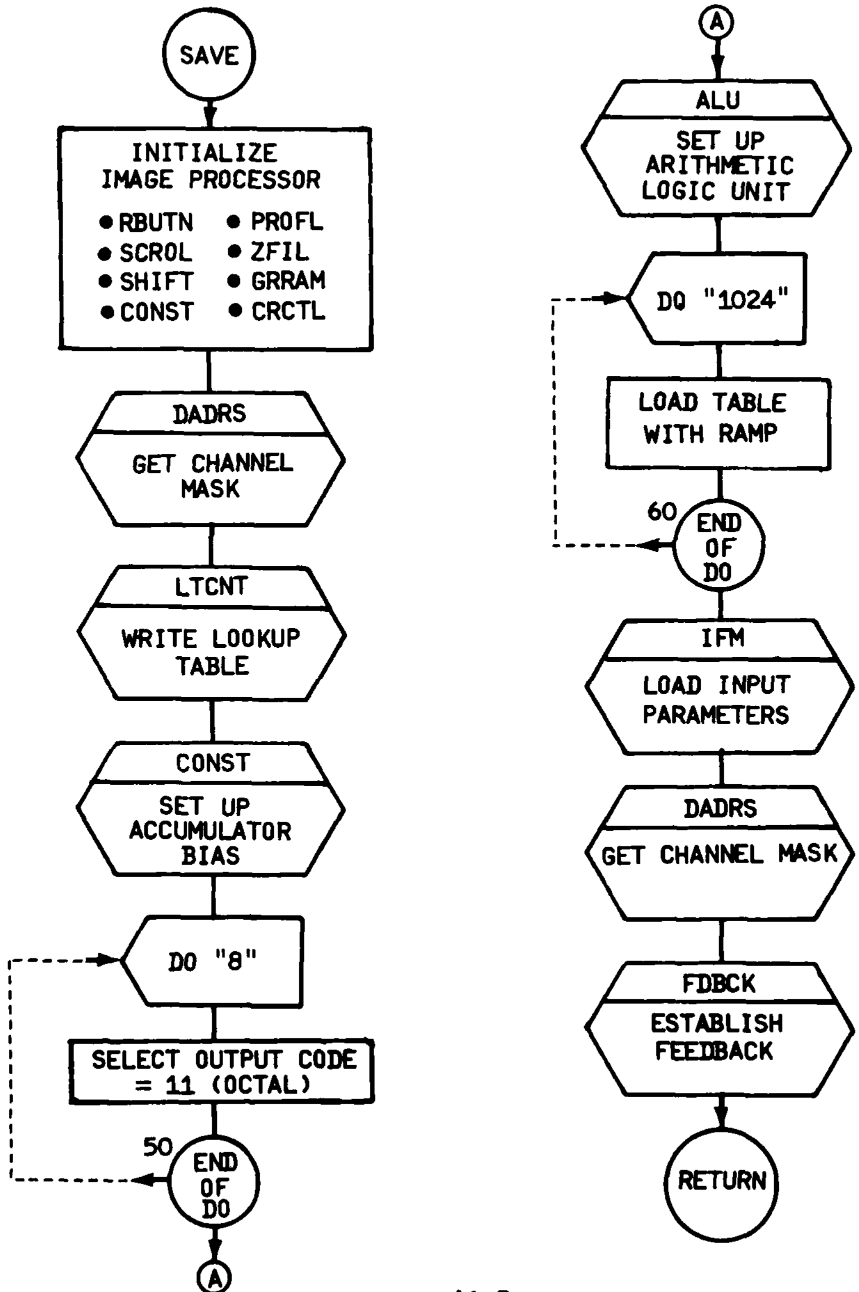
ARGUMENTS: 5
- INTEGER: FCB
- INTEGER: ZERO
- INTEGER: NIDS
- INTEGER: NODS
- INTEGER: BUFFER



SAVE - PRIMITIVE TO SAVE OUTPUT OF PIPELINE

ARGUMENTS: 7

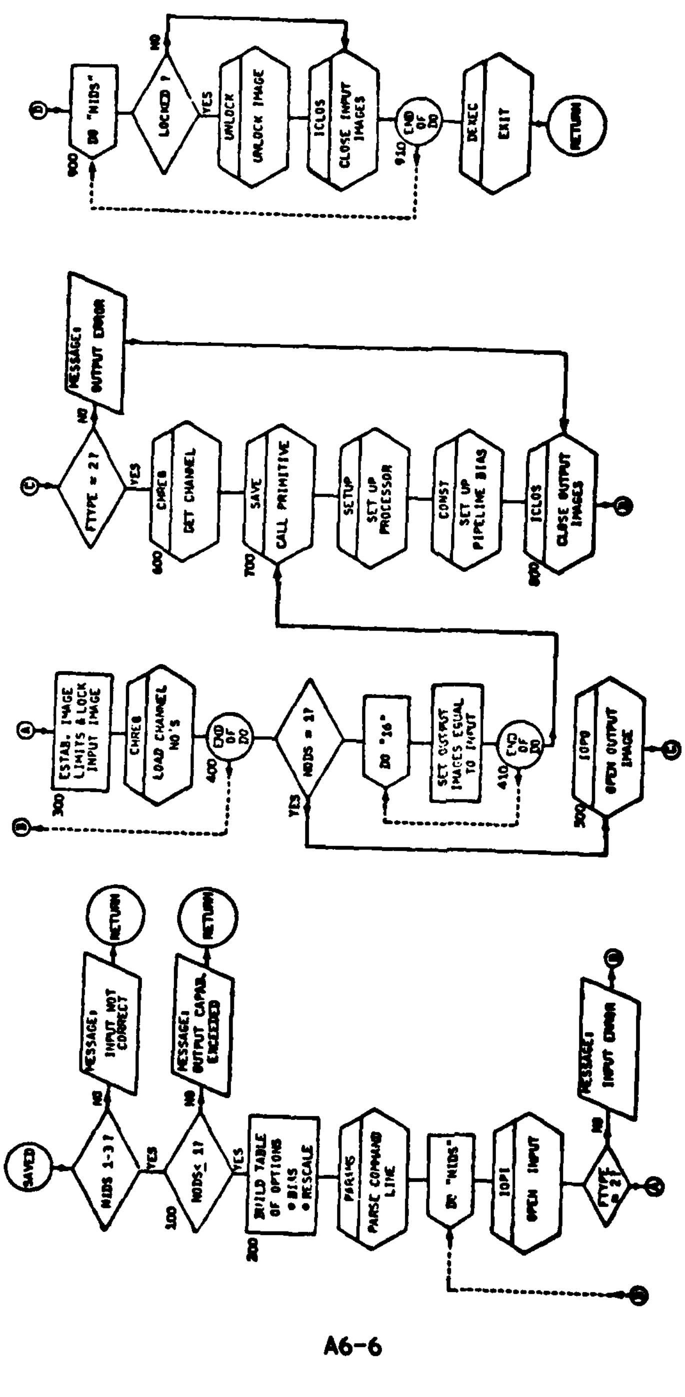
- INTEGER: FCB
- INTEGER: BUFFER
- INTEGER: ICHNNO
- INTEGER: DCHNNO
- INTEGER: NBANDS
- INTEGER: BIAS
- REAL: RSCALE



SAVED - SAVE THE OUTPUT OF THE PIPELINE

ARGUMENTS: 5

- INTEGER: FCB
- INTEGER: ZERO
- INTEGER: NIDS
- INTEGER: NODS
- INTEGER: IBUFF



```
C  DAVG: PRIMITIVE FOR AVERAGING VIDEO FRAMES
C
C    ****************************************************************
C    *                                                              *
C    *         REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM         *
C    *         VERSION 1.0     JUNE 1,1980                          *
C    *         BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY        *
C    *                                                              *
C    ****************************************************************
C
C
C       MODIFIED TO RUN FROM AUTOMATIC INSPECTION SYSTEM
C
        SUBROUTINE DAVG (FCB, BUFFER, N, WAIT, MIN, MAX, MINMAX, BATCH)
C
C  DESCRIPT -  PRIMITIVE TO AVERAGE 'N' FRAMES IN THE ACCUMULATOR,
C              AND DISPLAY THE RESULT. CYCLE REPEATS UNTIL STOPPED
C              OR SAVED BY BUTTON PUSH. (DELETED)
C
C  PASSED IN - BUFFER         WORK SPACE (1024+)
C              N              NUMBER OF FRAMES TO AVERAGE / CYCLE
C              WAIT           TIME IN 1/10TH OF SEC. TO DISPLAY IMAGE
C              MIN            1ST BREAKPOINT ON IFM PIECEWISE MAPPING
C              MAX            2ND BREAKPOINT ON IFM PIECEWISE MAPPING
C              MINMAX         KEYWORD FOR AUTOMATIC RANGE FINDING
C
C  RETURNED -  NONE
C
C  SUBS -      M70OP          GETS VERSION INFORMATION
C              GBITS          FILLS ARRAY WITH BIT PATTERN IN WORD
C              PBITS          FILLS WORD WITH BIT PATTERN IN ARRAY
C              DMASK          COMPUTES CHANNEL MASK FROM CHANNEL NUMBER
C              RBUTN          CLEAR THE BUTTON WORD (DELETED)
C              SCROL          CLEAR THE SCROL REGISTER
C              SHIFT          CLEAR THE OFM SELECT SHIFT
C              CONST          CLEAR CONSTANT REGISTER
C              LTCNT          WRITES LUT MASK TO ENABLE CHANNELS
C              MNMAX          FIND THE MINIMUM AND MAXIMUM OF IMAGE
C              LUT            LOADS THE LUT WITH SPECIFIED MAP
C              OFM            LOADS THE OFM WITH SPECIFIED MAP
C              ALU            DEFINES ALU OPERATION
C              FDBCK          WRITES THE FEEDBACK LOOP CONTROL WORD
C              DEXEC          FLUSHES THE M70 COMMAND BUFFER
C              DWAIT          PAUSE FOR AWHILE
C              IFM            LOADS THE IFM WITH SPECIFIED MAP
C
        INTEGER FCB(1), BUFFER(1)
        INTEGER N, WAIT, MIN, MAX
        LOGICAL MINMAX
C
        INTEGER VRSION, DIGCHN, DIGMSK
        INTEGER X, Y
        INTEGER OUTSEL(8)
        REAL SLOPE
C
        INTEGER PBITS, DMASK              /* EXTERNAL FUNCTIONS
C
C  GET VERSION INFO
C
        CALL M70OP (FCB, VRSION, NCHAN, LEVELS, IRMEM, I, I, I,
     1             IFDBCK, I, I, I, I, I, I, I, I, I, I, I)
C
C  GET DIGITIZER CHANNEL NUMBER
C
        CALL GBITS (IRMEM, BUFFER, 16)
        DIGCHN = PBITS (BUFFER(9), 4)
        DIGMSK = DMASK (DIGCHN)
C
C  INITIALIZE M70
C
        CALL SCROL (FCB, 0, 0, 17, 0, 0)
        CALL SHIFT (FCB, 0, 0, 0, 0, 0)
        CALL CONST (FCB, 0, 0, 0, 0, 0)
```

```
      CALL PROFL (FCB, 0, 0, 0, 0, 0)
      CALL ZFIL (BUFFER, 512, 0)
      CALL GRRAM (FCB, BUFFER, 0, 0)
      CALL CRCTL (FCB, 0, 0, 0, 0, 0, 0, 0, 0, 0)
C
C IF N > 32 THEN DON'T NEED TO LOAD IFM
C
      IF(N .GT. 32)GO TO 140
      NN=N
      IF(N .EQ. 32)NN=16
      SLOPE=1./FLOAT(NN)
C
      DO 120 J=1,NN
         DO 110 I=1,512
            ISTART=(J-1)*512
            IDX=ISTART+I-1
            BUFFER(I)=IFIX(IDX*SLOPE)
110      CONTINUE
C
         CALL IFM(FCB,BUFFER,ISTART,512,0,0,0)
C
C              FCB
C              MAP       =       IFM CONTENTS
C              START     =       ZERO RELATIVE POSITION OF STARTING POINT
C              COUNT     =       THE NUMBER OF IFM ELEMENTS TO TRANSFER
C              PACK      =       1 IMPLIES PACKED MODE
C              VRTRTC    =
C              READ      =       0 IMPLIES WRITE, 1 IMPLIES READ
C
120   CONTINUE
C
C DEFINE AND LOAD LUT MAP FOR DIGITIZING CHANNEL FOR SLOPE OF 1
C
140   DO 22 I=1,256
         BUFFER(I)=I-1
22    CONTINUE
C
      CALL LUT(FCB,BUFFER,DIGMSK,7,0,0)
C
C CHECK IF WANT DIFFERENT SCALING
C
      IF( .NOT. MINMAX)GO TO 310
C
C ENABLE THE DIGITIZING LUT, GET MIN AND MAX, RELOAD LUT
C
      CALL LTCNT(FCB,DIGMSK,7,0,0)
      CALL MNMAX(FCB,MIN,MAX,I,I,I,I)
310   MINP1=MIN+1
C
      DO 305 I=1,MINP1
         BUFFER(I)=0
305   CONTINUE
C
      SLOPE=255./(MAX-MIN)
      MINP2=MINP1+1
C
      DO 320 I=MINP2,MAX
         BUFFER(I)=IFIX((I-MINP1)*SLOPE+.5)
320   CONTINUE
C
      MAXP1=MAX+1
C
      DO 340 I=MAXP1,256
         BUFFER(I)=255
340   CONTINUE
C
      CALL LUT(FCB,BUFFER,7,DIGMSK,0,0)
C
C              FCB
C              MAP       =       MAP FUNCTION FOR LUT
C              COLOR     =       BIT MASK FOR WHICH LUTS TO WRITE
C              VRTRTC    =
C              READ      =       0 IMPLIES WRITE, 1 IMPLIES READ
```

```
C
C LOAD THE OTHER LUTS
C
      DO 40 I=1,256
         BUFFER(I)=I-1
40    CONTINUE
C
      CALL LUT(FCB,BUFFER,7,7,0,0)
C
C              FCB
C              MAP       =      MAP FUNCTION FOR LUT
C              COLOR     =      BIT MASK FOR WHICH LUT'S TO WRITE
C              CHANNL    =      CHANNEL CODE BIT MAP
C              VRTRTC
C              READ      =      0 IMPLIES WRITE, 1 IMPLIES READ
C
C SET UP THE ALU TO ACCOMPLISH AN 'A + B'
C
      DO 70 I=1,8
         OUTSEL(I)=:12                         /*ALU OUTPUT
70    CONTINUE
C
      CALL ALU(FCB,0,:11,:11,BUFFER,OUTSEL,1,0,0,0,I,I,0)
C
C              MODE      =      0 IMPLIES ARITHMETIC, 1 IMPLIES LOGICAL
C              BFUNC     =      BLOTCH FUNCTION (:11 IMPLIES A + B)
C              NFUNC     =      NORMAL FUNCTION (:11 IMPLIES A + B)
C              CONST     =      8 WORD INTEGER CONSTANT ARRAY
C              OUTSEL    =      SELECTION (:12 IMPLIES ALU OUTPUT)
C              EFOM      =      1 IMPLIES EXTEND SIGN BIT
C              ESHIFT    =      RIGHT SHIFT OUTPUT WITH SIGN EXTENSION
C              CARYIN    =      OVERFLOW FLAG SET ONLY DURING READ
C              CARRY     =      OVERFLOW FLAG SET ONLY DURING READ
C              EQUAL     =      FRAME EQUALITY FLAG SET DURING READ
C              READ      =      0 IMPLIES WRITE, 1 IMPLIES READ
C
C CLEAR THE ACCUMULATOR
C
      CALL FDBCK(FCB,2,3,-1,1,0,0,1,1,0)
C
C              FCB
C              COLOR     =      BIT MASK SELECTING COLOR
C              CHANL     =      BIT MAP SELECTING CHANNEL
C              BITP      =      BIT MAP SELECTING BIT PLANES
C              BYPIFM    =      0 IMPLIES USE IFM, 1 IMPLIES BYPASS IFM
C              PIXOFF    =      PIXEL OFFSET
C              EXTERN    =      1 IMPLIES EXTERNAL INPUT
C              ZERO      =      0 IS NORMAL, 1 IMPLIES FEEDBACK ALL 0'S
C              ACCUM     =      1 IMPLIES ACCUMULATOR MODE
C              ADWRT     =      1 IMPLIES ADDITIVE WRITE
C
C ENABLE THE LUTS FOR THE DIGITIZER TO GET A BLACK & WHITE PICTURE
C
      CALL LTCNT(FCB,DIGMSK,7,0,0)
C
C              FCB
C              MASK      =      BIT MASK FOR WHICH LUTS TO ENABLE
C              COLOR     =      BIT MASK FOR WHICH COLORS TO ENABLE
C              VRTRTC
C              READ      =      0 IMPLIES WRITE, 1 IMPLIES READ
C
C RELOAD OFMS WITH POSITIVE UNITY TRANSFORM
C
      DO 198 I=1,512
         BUFFER(I)=I-1
198   CONTINUE
C
      CALL OFM(FCB,BUFFER,7,0,0)
C
C FEEDBACK N TIMES
C
      DO 80 I=1,N
         CALL FDBCK(FCB,2,3,-1,1,0,0,0,1,0)
```

```
C
C                FCB
C                COLOR    =       4,2,1 FOR RED,GREEN,BLUE  (ORDER?)
C                CHANL    =       BIT MASK SELECTING DESTINATION CHANNEL
C                BITP     =       BIT MASK SELECTING BIT PLANES
C                BYPIFM   =       0 IMPLIES USE IFM, 1 IMPLIES BYPASS IFM
C                PIXOFF   =
C                EXTERN
C                ZERO
C                ACCUM
C                ADWRT
C
80      CONTINUE
C
C SET UP ALU OST FOR ACCUMULATOR
C
        DO 50 I=1,8
           OUTSEL(I)=:10
50      CONTINUE
C
        CALL ALU(FCB,0,:14,:14,BUFFER,OUTSEL,0,0,0,0,0,0,0)
C
C                FCB
C                MODE     =       0 IS ARITHMETIC, 1 IMPLIES LOGICAL
C                BFUNC    =      SET FOR A+A (USED WHEN N>32)
C                NFUNC    =      SET FOR A+A (USED WHEN N>32)
C                CONST    =
C                OUTSEL=          OUTPUT SELECTION ARRAY
C                EOFM     =
C                ESHIFT   =
C                SHIFT    =
C                CARYIN   =
C                CARRY    =
C                EQUAL    =
C                READ     =
C
        IF(N .LE. 32)GO TO 600
C
C OTHERWISE SHIFT DATA UP TO THE MSB
C
C SET ALU FOR ALU OUTPUT
C
        DO 88 I=1,8
           OUTSEL(I)=:12
88      CONTINUE
C
        CALL ALU(FCB,0,:14,:14,BUFFER,OUTSEL,0,0,0,0,0,0,0)
C                FCB
C                MODE     =       0 IMPLIES ARITHMETIC
C                BFUNC    =       ALU FUNCTION IN ROI (:14 IMPLIES A+A)
C                NFUNC    =       ALU FUNCTION OUTSIDE ROI (:14 IMPLIES A+A)
C                CONST    =       8 WORD CONSTANT ARRAY
C                OUTSEL   =       OUTPUT SELECTION ARRAY
C                EOFM     =       SIGN EXTEND OFM
C                ESHIFT   =       SIGN EXTEND RIGHT SHIFT
C                SHIFT    =       RIGHT SHIFT
C                CARYIN   =       SETS THE CARRY IN CONDITION
C                CARRY    =
C                EQUAL    =
C                READ     =       0 IMPLIES WRITE, 1 IMPLIES READ
C
C
        IF(N .EQ. 64)GO TO 500
        IF(N .EQ. 128)GO TO 510
        IF(N .EQ. 256)GO TO 520
        GO TO 600
C
C
C MULTIPLY BY TWO BY FEEDING BACK AND DOING A+A
C
500     CALL FDBCK(FCB,0,3,-1,1,0,0,0,1,0)
C
510     CONTINUE
```

```
C
C MULTIPLY BY TWO BY FEEDING BACK AND DOING A+A
C
       CALL FDBCK(FCB,0,3,-1,1,0,0,0,1,0)
C
C SET ALU OST FOR OFM AND THEN FEED BACK THE 2ND CHANNEL TO THE 1ST
C
520    DO 99 I=1,8
          OUTSEL(I)=:11
99     CONTINUE
       CALL ALU(FCB,0,:14,:14,BUFFER,OUTSEL,0,0,0,0,0,0,0)
       CALL LTCNT(FCB,2,7,0,0)
       CALL FDBCK(FCB,2,1,-1,1,0,0,0,0,0,0)
       GO TO 444
C
C FEEDBACK 1 TIME THRU THE IFM TO ACCOMPLISH A DIVIDE BY N
C AND PUT IN 1ST MEMORY CHANNEL
C
600    CALL FDBCK(FCB,2,1,-1,0,0,0,0,0,0)
C
C ENABLE THE LUTS FOR THE CHANNEL THAT THE OUTPUT WAS FED BACK TO
C
444    CALL LTCNT(FCB,1,7,0,0)
C
C SCALE UP BY RELOADING OFMS WITH SLOPE OF 4
C
       DO 294 I=1,512
          BUFFER(I)=I+I+I+I-4
          BUFFER(512+I)=512+I+I+I+I-4
294    CONTINUE
C
       CALL OFM(FCB,BUFFER,7,0,0)
C
C TRANSFER COMMAND BUFFER TO MODEL 70
C
       CALL DEXEC (FCB)
C
       RETURN
       END
```

```
C   DAVGD: INTERFACE FOR VIDEO AVERAGEING.
C
C     *****************************************************************
C     *                                                               *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM         *
C     *          VERSION 1.0     JUNE 1,1980                          *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY        *
C     *                                                               *
C     *****************************************************************
C
C
C       MODIFIED TO RUN FROM AUTOMATIC INSPECTION SYSTEM
C
C
        SUBROUTINE DAVGD (FCB, ZERO, NIDS, NODS, BUFFER)
C
C   DESCRIPT -  DIGITIZES A VIDEO IMAGE AND SUMS FRAMES IN THE ACCUMULATOR
C               TO DISPLAY A FRAME AVERAGE IN SEMI-REAL TIME.
C               SETS UP PARAMETER SYSTEM FOR CALL TO DAVG.
C               WRITTEN BY DAN KINNEY, BOEING QAT, 3/17/80
C
C
        INTEGER ZERO(1), FCB(1), BUFFER(1)
        INTEGER NIDS, NODS
C
        INTEGER OCHNNO(16)
        INTEGER ODSRN, DTYPE, FTYPE, NS, NL, NBANDS
        INTEGER N, WAIT, MIN, MAX
        LOGICAL MINMAX, BATCH
        INTEGER INAMES(48), CODES(6), SIZES(6), COUNTS(6), NPARMS
        INTEGER*4 ADDRI, ADDRR, ADDRS(6)
C
C
C   BUILD PARAMETER PROMPTS
C
C
C    SET N = 16 DEFAULT
        CALL ZMVD ('N                ',INAMES(1), 16)
        CODES(1) = 0
        SIZES(1) = 1
        ADDRS(1) = ADDRI (N)
        COUNTS(1) = 0
        N = 16
C
C   SET DEFAULT WAIT TO 10
        CALL ZMVD ('WAIT             ',INAMES(9), 16)
        CODES(2) = 0
        SIZES(2) = 1
        ADDRS(2) =  ADDRI (WAIT)
        COUNTS(2) = 0
C
        WAIT = 10
C
C    SET MIN = 0, DEFAULT
        CALL ZMVD ('MIN              ',INAMES(17), 16)
        CODES(3) = 0
        SIZES(3) = 1
        ADDRS(3) = ADDRI (MIN)
        COUNTS(3) = 0
        MIN = 0
C
C    SET MAX = 255 (DEFAULT)
        CALL ZMVD ('MAX              ',INAMES(25), 16)
        CODES(4) = 0
        SIZES(4) = 1
        ADDRS(4) = ADDRI (MAX)
        COUNTS(4) = 0
        MAX = 255
C
        CALL ZMVD ('MINMAX           ',INAMES(33), 16)
        CODES(5) = 3
        COUNTS(5) = 0
C
        CALL ZMVD ('BATCH            ',INAMES(41), 16)
```

```
      CODES(6) = 3
      COUNTS(6) = 0

      NPARMS = 6
C
      CALL PARAMS (FCB, INAMES, CODES, SIZES, ADDRS, COUNTS, NPARMS)
      IF (N .LT. 1) N = 2
      IF (N .GT. 256) N = 256
      N = 2**IFIX(ALOG(FLOAT(N))/ALOG(2.))
      IF (MIN .LT. 0) MIN = 0
      IF (MIN .GE. MAX) MIN = 0
      IF (MAX .LE. MIN) MAX = 255
      IF (MAX .GT. 255) MAX = 255
C
      IF (COUNTS(5).EQ.1)  MINMAX = .TRUE.
      IF (COUNTS(6).EQ.1)  BATCH = .TRUE.
C
C   OPEN OUTPUT DISPLAY IMAGE
      ODSRN = 1
      DTYPE = 1
      FTYPE = 2
      NS = 512
      NL = 512
      NBANDS = 1
C
C
C   DO ACTUAL DIGITIZING AND SUMMATION
      CALL DAVG (FCB, BUFFER, N, WAIT, MIN, MAX, MINMAX, BATCH)
      NLEVS = 256
      OCHNNO(1) = 0
      CALL SETUP (FCB, BUFFER, NBANDS, NLEVS, OCHNNO, 0, 1)
C
C   CLEAN UP
      CALL ICLOS (FCB, ODSRN)
      RETURN
      END
```

```
C   SAVE: PRIMATIVE TO SAVE OUTPUT OF PIPELINE
C
C     *************************************************************
C     *                                                           *
C     *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM     *
C     *          VERSION 1.0    JUNE 1,1980                       *
C     *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY    *
C     *                                                           *
C     *************************************************************
C
      SUBROUTINE SAVE (FCB, BUFFER, ICHNNO, OCHNNO, NBANDS,
     .                 BIAS, RSCALE)
C
C     WRITTEN BY DAN KINNEY, BOEING QAT R&D, 4/21/80.
C
C  DESCRIPT -  PRIMITIVE TO SAVE THE PIPELINE OUTPUT OF A DISPLAY
C              IMAGE IN REFRESH MEMORY
C
C  PASSED IN - BUFFER          INTEGER WORK SPACE (1024+)
C              ICHNNO          ARRAY OF INPUT CHANNEL NUMBERS
C              OCHNNO          ARRAY OF OUTPUT CHANNEL NUMBERS
C              NBANDS          NUMBER OF BANDS IN INPUT IMAGE
C              BIAS            CONSTANT VALUE TO BE ADDED TO IMAGE
C              RSCALE          RESCALE FACTOR
C
C  RETURNED -  NONE
C
C  SUBS -      DADRS
C              LTCNT
C              CONST           LOADS CONSTANT REGISTERS
C              ALU             DEFINES THE ALU OPERATION
C              IFM
C              FDBCK           WRITES THE FEEDBACK LOOP CONTROL WORD
C
C  CHANGES -   COMPUTATION OF IFM RAMP CHANGED FROM 'I*RESCALE' TO
C              '(I-1)*RESCALE'                          JON 6/9/80.
C
C
      INTEGER FCB(1), BUFFER(1)
      INTEGER ICHNNO(16), OCHNNO(16), NBANDS
      INTEGER BIAS
      REAL RSCALE
      INTEGER CHMASK(16), CHCODE
      INTEGER OUTSEL(8)
      INTEGER BUTTON, X, Y
C
C
C              INITIALIZE M70
      CALL RBUTN (FCB, BUTTON, X, Y)
      CALL SCROL (FCB, 0, 0, 17, 0, 0)
      CALL SHIFT (FCB, 0, 0, 0, 0, 0)
      CALL CONST (FCB, 0, 0, 0, 0, 0)
      CALL PROFL (FCB, 0, 0, 0, 0, 0)
      CALL ZFIL (BUFFER, 512, 0)
      CALL GRRAM (FCB, BUFFER, 0, 0)
      CALL CRCTL (FCB, 0, 0, 0, 0, 0, 0, 0, 0, 0)
C
C              COMPUTE INPUT CHANNEL MASK FROM CHANNEL CODE ARRAY
      CALL DADRS (CHMASK, ICHNNO, CHCODE, NBANDS)
C              WRITE LUT MASK TO SELECT INPUT IMAGE OR IMAGES
      CALL LTCNT (FCB, CHCODE, 7, 0, 0)
C              /* MASK  =  CHCODE       MASK FOR WHICH CHANNELS TO ENABLE
C              /* COLOR =  7            MASK FOR WHICH COLORS TO ENABLE
C
C              SET UP CONSTANT REGISTERS FOR BIASING IMAGE AFTER ADDER
      CALL CONST (FCB, BIAS, BIAS, BIAS, 0, 0)
C
C              SET UP ALU
      DO 50 I=1,8
         OUTSEL(I) = :11
   50 CONTINUE
C
C              DEFINE ALU OPERATION
```

```
      CALL ALU (FCB, 0, 0, 0, BUFFER, OUTSEL, 0, 0, 0, 0, 0, 0, 0)
C             /* OUTSEL = :11          PIPELINE OUTPUT
C
C
C             DEFINE IFM RESCALE MAP
C     THE .25 = 1/(2**2) WHICH SCALES 10 BIT TV DOWN TO 8 BIT MEMORY
      DO 60 I=1,1024
         BUFFER(I) = (I-1) * RSCALE * .25
   60 CONTINUE
C
      CALL IFM (FCB, BUFFER, 0, 1024, 0, 0, 0)
C             /* MAP   =  BUFFER        RESCALE RAMP FUNCTION
C             /* START = 0              FIRST POSITION TO LOAD IN IFM
C             /* COUNT = 1024           NUMBER OF ELEMENTS TO TRANSFER
C             /* PACK  = 0              1 IMPLIES PACKED MODE TRANSFER
C             /* VRTRTC = 0             WAIT FOR VERTICAL RETRACE INTERVAL
C             /* READ  = 0              0 IMPLIES READ, 1 IMPLIES WRITE
C
C             COMPUTE OUTPUT CHANNEL MASK FROM CHANNEL CODE ARRAY
      CALL DADRS (CHMASK, OCHNNO, CHCODE, NBANDS)
C             WRITE THE FEEDBACK LOOP CONTROL WORD
      CALL FDBCK (FCB, 1, CHMASK, -1, 0, 0, 0, 0, 0, 0)
C             /* COLOR  = 1             4, 2, 1, FOR RED, GREEN, AND BLUE
C             /* CHANL  = CHMASK        BIT MASK SELECTING DESTINATION CHANNEL
C             /* BITP   =  -1           BIT MASK SELECTING THE BIT PLANES
C             /* BYPIFM = 0             0 IMPLIES USE IFM, 1 IMPLIES BYPASS IFM
C
      RETURN
      END
```

```
C   SAVED: SAVE THE OUTPUT OF THE PIPELINE
C
C    ***************************************************************
C    *                                                             *
C    *          REAL TIME XRAY - AUTOMATED INSPECTION SYSTEM      *
C    *          VERSION 1.0    JUNE 1,1980                        *
C    *          BOEING AEROSPACE QUALITY ASSURANCE TECHNOLOGY     *
C    *                                                             *
C    ***************************************************************
C
      SUBROUTINE SAVED (FCB, ZERO, NIDS, NODS, IBUFF)
C
C     WRITTEN BY DAN KINNEY, BOEING QAT R&D, 4/21/80.
C
C     DESCRIPTION:  SAVED calls the primitive SAVE to save the pipeline
C                   output  of a display image in refresh memory.
C
C               specify passed variables
      INTEGER ZERO(1), FCB(1), IBUFF(1)
      INTEGER NIDS, NODS
C
C               specify input and output image variables
      INTEGER ICHNNO(16), OCHNNO(16)
      INTEGER IDSRN, ODSRN, DTYPE, FTYPE, NS, NL, NBANDS
      INTEGER IDX, NLEVS
C
C               specify parameter system variables
      INTEGER INAMES(16), CODES(2), SIZES(2), COUNTS(2), NPARMS
      INTEGER*4 ADDRI, ADDRR, ADDRS(2)
      INTEGER BIAS
      REAL RSCALE
C
      LOGICAL LOCKED(16)
      INTEGER ICBPT, CHAN1, ILOCK
C
C               check value of NIDS
      IF (1.LE.NIDS .AND. NIDS.LE.3) GOTO 100
         CALL TNOUA ('ERROR:  ',8)
         CALL TNOU ('NO INPUT, OR MORE THEN THREE INPUTS SPECIFIED',45)
         RETURN
C
  100 CONTINUE
C               check value of NODS
      IF (NODS.LE.1) GOTO 200
         CALL TNOUA ('ERROR:  ',8)
         CALL TNOU ('MORE THEN ONE OUTPUT SPECIFIED',30)
         RETURN
C
  200 CONTINUE
C               build parameter system prompts
      CALL ZMVD ('BIAS            ',INAMES(1), 16)
      CODES(1) = 0
      SIZES(1) = 1
      ADDRS(1) = ADDRI (BIAS)
      COUNTS(1) = 0
      BIAS = 0
C
      CALL ZMVD ('RESCALE         ',INAMES(9), 16)
      CODES(2) = 1
      SIZES(2) = 1
      ADDRS(2) = ADDRR (RSCALE)
      COUNTS(2) = 0
      RSCALE = 1.0
C
      NPARMS = 2
C
C               call parameter system to check/prompt options
      CALL PARAMS (FCB, INAMES, CODES, SIZES, ADDRS, COUNTS, NPARMS)
C
C               open input image
      IDX = 1
      DO 400 IDSRN = 1,NIDS
         CALL IOPI (FCB, IBUFF, IDSRN, DTYPE, FTYPE, NS, NL, NBANDS)
```

```
            IF (FTYPE.EQ.2) GOTO 300
               CALL TNOUA ('ERROR:  ',8)
               CALL TNOU ('INPUT MUST BE A DISPLAY IMAGE',29)
               GOTO 900
  300       CONTINUE
C                 prevent memory management from overwritting image
            ICBPT = IDSRN * 256
            CHAN1 = FCB(ICBPT+87)
            ILOCK = AND (ZERO(906+CHAN1), :17)
            LOCKED(IDSRN) = .FALSE.
            IF (ILOCK .EQ. 2) LOCKED(IDSRN) = .TRUE.
            IF (.NOT.LOCKED(IDSRN)) CALL LOCK (FCB, IDSRN)
C
C                 load array with channel number corresponding to each band
            CALL CHREQ (FCB, IDSRN, ICHNNO(IDX), NLEVS)
            IDX = IDX + NBANDS
  400   CONTINUE
        NBANDS = IDX - 1
C
C                 open output image
        IF (NODS.EQ.1) GOTO 500
C                 IF NO OUTPUT IS SPECIFIED, OVERWRITE THE IMAGE
        DO 410 I=1,16
            OCHNNO(I) = ICHNNO(I)
  410   CONTINUE
        GOTO 700
C
  500   CONTINUE
        ODSRN = NIDS + 1
        CALL IOPO (FCB, IBUFF, ODSRN, DTYPE, FTYPE, NS, NL, 1)
        IF (FTYPE.EQ.2) GOTO 600
            CALL TNOUA ('ERROR:  ',8)
            CALL TNOU ('OUTPUT MUST BE A DISPLAY IMAGE',30)
            GOTO 800
  600   CONTINUE
        CALL CHREQ (FCB, ODSRN, OCHNNO, NLEVS)
C
  700   CONTINUE
C                 Call subroutine or primative to do the actual operation
        CALL SAVE (FCB, IBUFF, ICHNNO, OCHNNO, NBANDS, BIAS, RSCALE)
        CALL SETUP (FCB, IBUFF, NBANDS, NLEVS, OCHNNO, 0, 1)
        CALL CONST (FCB, BIAS, BIAS, BIAS, 0, 1)
C
  800   CONTINUE
C                 close all output images
        CALL ICLOS (FCB, ODSRN)
C
  900   CONTINUE
C                 close all input images
        DO 910 IDSRN = 1,NIDS
            IF (.NOT.LOCKED(IDSRN)) CALL UNLOCK (FCB, IDSRN)
            CALL ICLOS (FCB, IDSRN)
  910   CONTINUE
C
C                 exit
        CALL DEXEC (FCB)
        RETURN
        END
```

APPENDIX 7

SUPPORTING SOFTWARE DESCRIPTIONS

APPENDIX 7
SUPPORTING SOFTWARE DESCRIPTIONS

A BRIEF DESCRIPTION OF EACH OF THE ADDITIONAL SUBROUTINES USED IN THE COMPUTER-AIDED INSPECTION SOFTWARE IS LISTED BELOW FOR CLARITY. ALL ARGUMENTS ARE 16 BIT INTEGERS (INTEGER*2) UNLESS OTHERWISE NOTED.

```
ADD1$ (CHAN,BUFFER,KEY,ARRAY,FLAGS,ALTRTN,INDEX,FNO,BUFLEN,KEYLEN)
      ADD1$ IS A MIDAS (MULTIPLE INDEX DATA ACCESS SYSTEM) SUBROUTINE
      USED TO ADD A RECORD AND PRIMARY KEY OR A SECONDARY KEY TO A
      DATA-BASE. THE ARGUMENTS ARE:
       CHAN   = SYSTEM CHANNEL NUMBER TO THE DATA FILE.
       BUFFER = AN ARRAY IN MEMORY CONTAINING THE RECORD TO BE ADDED,
                OR THE PRIMARY KEYWORD IF A SECONDARY KEY IS ADDED.
       KEY    = KEYWORD TO BE ADDED TO THE INDEX.
       ARRAY  = A 14 WORD ARRAY CONTAINING INDEX AND RECORD POINTERS AND
                ERROR CODE.
       FLAGS  = A 16 BIT WORD USED TO PASS OPTION CONDITIONS TO MIDAS.
       ALTRTN = RETURN TAKEN IF ANY ERROR OCCURES.
       INDEX  = INDEX LEVEL, 0 = PRIMARY, 1-19 FOR SECONDARIES.
       FNO    = FILE NUMBER, ALWAYS = 0
       BUFLEN = LENGTH OF DATA BUFFER, 0 IF WHOLE RECORD.
       KEYLEN = LENGTH OF KEYWORD, 0 IF WHOLE KEYWORD.

CLEAN
      CLEAN IS A SUBROUTINE FROM THE STC SYSTEM 500 SOFTWARE USED TO
      INITIALIZE THE MODEL 70 HARDWARE AND CLEAN THE IMAGE DIRECTORY.
      THIS SUBROUTINE WAS MODIFIED TO BE COMPATIBLE WITH AUTOMATIC
      OPERATION.

CLOS$A (ICH)
      PRIME SUPPLIED SUBROUTINE USED TO CLOSE A DISK FILE.  ICH IS
      CHANNEL TO BE CLOSED.

CMDM70 (COMD,ERR)
      CMDM70 PASSES A COMMAND TO THE STC SYSTEM 500.  THIS SUBROUTINE
      WAS WRITEN TO BE COMPATIBLE WITH AUTOMATIC PROCESSES.  THE
      ARGUMENTS ARE:
       COMD   = COMMAND LINE IN SYSTEM 500 FORMAT.
       ERR    = ERROR CODE, 0 = NO ERROR.

CMLDR
      CMLDR IS A SYSTEM 500 SUBROUTINE USED TO LOAD DATA INTO COMMON.
      IT WAS MODIFIED TO BE COMPATIBLE WITH AUTOMATIC OPERATION.

CNVB$A (KEY,VALUE,BUFFER,BUFLEN)
      CNVB$A IS A PRIME SUPPLIED SUBROUTINE TO CONVERT A DOUBLE
      PRECISION INTEGER TO ASCII.  THE ARGUMENTS ARE:
       KEY    = KEY FOR CONVERSION TO OCTAL, DECIMAL, OR HEXIDECIMAL.
       VALUE  = 4 BYTE INTEGER TO BE CONVERTED.
       BUFFER = ARRAY TO RECEIVE ASCII CONVERSION.
       BUFLEN = LENGTH OF ARRAY IN BYTES.

CSTR$A (TEXTA,LENA,TEXTB,LENB)
      CSTR$A IS A LOGICAL FUNCTION SUPPLIED BY PRIME USED TO COMPARE TWO
      TEXT STRINGS.  ITS VALUE IS TRUE IF THE STRINGS COMPARE. THE
      ARGUMENTS ARE:
       TEXTA  = FIRST STRING FOR REFERENCE.
       LENA   = LENGTH OF TEXTA IN BYTES.
       TEXTB  = SECOND STRING TO COMPARE.
       LENB   = LENGTH OF TEXTB.
```

```
DATE$A (BUFFER)
      DATE$A IS A DOUBLE PRECISION REAL FUNCTION SUPPLIED BY PRIME, AND
      IS USED TO GET THE CURRENT DATE.  THE VALUE OF THE FUNCTION IS
      ASCII IN THE FORM OF 'MM/DD/YY'.  THE ARUGUMENT IS:
       BUFFER = DATE IN THE FORM 'DAY, MON DD YEAR', AND MUST BE AT
                LEAST 16 BYTES LONG.

DELE$A (FILE,LEN)
      DELE$A IS A LOGICAL FUNCTION SUPPLIED BY PRIME, USED TO DELETE A
      FILE.  THE FUCNTION IS RETURNED TRUE IF SUCCESSFUL.  THE ARGUMENTS
      ARE:
       FILE   = NAME OF FILE TO BE DELETED.
       LEN    = LENGTH OF FILE NAME IN BYTES.

DELET$ (CHAN,BUFFER,KEY,ARRAY,FLAGS,ALTRTN,INDEX,FNO,BUFLEN,KEYLEN)
      DELET$ IS A MIDAS (MULTIPLE INDEX DATA ACCESS SYSTEM) SUBROUTINE
      USED TO DELETE A RECORD AND PRIMARY KEY OR A SECONDARY KEY FROM
      A DATA-BASE. THE ARGUMENTS ARE:
       CHAN   = SYSTEM CHANNEL NUMBER TO THE DATA FILE.
       BUFFER = AN ARRAY IN MEMORY CONTAINING THE RECORD TO BE DELETED,
       KEY    = KEYWORD TO BE DELETED FROM THE INDEX.
       ARRAY  = A 14 WORD ARRAY CONTAINING INDEX AND RECORD POINTERS AND
                ERROR CODE.
       FLAGS  = A 16 BIT WORD USED TO PASS OPTION CONDITIONS TO MIDAS.
       ALTRTN = RETURN TAKEN IF ANY ERROR OCCURES.
       INDEX  = INDEX LEVEL, 0 = PRIMARY, 1-19 FOR SECONDARIES.
       FNO    = FILE NUMBER, ALWAYS = 0
       BUFLEN = LENGTH OF DATA BUFFER, 0 IF WHOLE RECORD.
       KEYLEN = LENGTH OF KEYWORD, MUST BE 0

EXIT
      EXIT IS A PRIME SUBROUTINE USED TO RETURN TO THE OPERATING SYSTEM.

FILL$A (BUFFER,BUFLEN,'CHAR')
      FILL$A IS A PRIME SUPPLIED SUBROUTINE TO FILL AN ARRAY WITH BYTES
      OR CHARACTERS.  THE ARGUMENTS ARE:
       BUFFER = ARRAY TO BE FILLED.
       BUFLEN = NUMBER OF BYTES IN BUFFER.
       'CHAR' = THE CHARACTER TO USED TO FILL THE ARRAY. THE CHARACTER
                MUST BE LEFT JUSTIFIED.

GCHR$A (TEXT,POS)
      GCHR$A IS AN INTEGER FUNCTION SUPPLIED BY PRIME USED TO GET A
      CHARACTER FROM A TEXT STRING.  THE VALUE OF THE FUNCTION IS A
      LEFT JUSTIFIED, BLANK PADDED 2 BYTE INTEGER.  THE ARGUMENTS ARE:
       TEXT   = TEXT STRING SUPPLYING THE CHARACTER.
       POS    = POSITION IN TEXT OF CHARACTER WANTED.

LOCK$ (CHAN,BUFFER,KEY,ARRAY,FLAGS,ALTRTN,INDEX,FNO,BUFLEN,KEYLEN)
      LOCK$ IS A MIDAS (MULTIPLE INDEX DATA ACCESS SYSTEM) SUBROUTINE
      USED TO LOCATE AND LOCK A RECORD FOR EDITING AND UPDATING.
      THE ARGUMENTS ARE:
       CHAN   = SYSTEM CHANNEL NUMBER TO THE DATA FILE.
       BUFFER = AN ARRAY IN MEMORY CONTAINING THE RECORD TO BE LOCKED.
       KEY    = KEYWORD TO LOCATE THE RECORD.
       ARRAY  = A 14 WORD ARRAY CONTAINING INDEX AND RECORD POINTERS AND
                ERROR CODE.
       FLAGS  = A 16 BIT WORD USED TO PASS OPTION CONDITIONS TO MIDAS.
       ALTRTN = RETURN TAKEN IF ANY ERROR OCCURES.
       INDEX  = INDEX LEVEL, 0 = PRIMARY, 1-19 FOR SECONDARIES.
       FNO    = FILE NUMBER, ALWAYS = 0
       BUFLEN = LENGTH OF DATA BUFFER, MUST BE 0
       KEYLEN = LENGTH OF KEYWORD, MUST BE 0
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LSIZE (TEXT,LEN)
      LSIZE IS AN INTEGER FUNCTION USED TO DETERMINE THE LAST NON BLANK
      CHARACTER IN A TEXT STRING.  THE VALUE OF THE FUNCTION RETURNED IS
      THE BYTE COUNT OF THE LAST NON-BLANK CHARACTER.  THE ARGUMENTS
      ARE:
       TEXT    = TEXT STRING TO BE EXAMINED.
       LEN     = LENGTH OF TEXT.

MCHR$A (DTEXT,DPOS,STEXT,SPOS)
      MCHR$A IS A PRIME SUPPLIED SUBROUTINE USED TO MOVE ONE CHARACTER
      FROM ONE STRING TO ANOTHER.  THE ARGUMENTS ARE:
       DTEXT  = DESTINATION TEXT STRING.
       DPOS   = POSITION IN DESTINATION STRING.
       STEXT  = SOURCE TEXT STRING.
       SPOS   = POSITION IN SOURCE STRING.

MSTR$A (STEXT,LENS,DTEXT,LEND)
      MSTR$A IS A PRIME SUPPLIED SUBROUTINE USED TO MOVE A STRING FROM
      ONE ARRAY TO ANOTHER.  THE ARGUMENTS ARE:
       STEXT  = SOURCE TEXT.
       LENS   = LENGTH OF SOURCE STRING.
       DTEXT  = DESTINATION TEXT.
       LEND   = LENGTH OF DESTINATION ARRAY (BLANK PADDING OR TRUNCATION
                IS PERFORMED)

MSUB$A (STEXT,LENS,STARTS,ENDS,DTEXT,LEND,STARTD,ENDD)
      MSUB$A IS A PRIME SUPPLIED SUBROUTINE USED TO MOVE A TEXT STRING
      FROM ONE ARRAY TO ANOTHER.  THE ARGUMENTS ARE:
       STEXT  = SOURCE TEXT.
       LENS   = LENGTH OF SOURCE TEXT.
       STARTS = START POSITION IN SOURCE TEXT.
       ENDS   = END POSITION IN SOURCE TEXT.
       DTEXT  = DESTINATION TEXT.
       LEND   = LENGTH OF DESTINATION TEXT.
       STARTD = POSITION IN DESTINATION TEXT TO DEPOSIT TEXT.
       ENDD   = END POSITION IN DESTINATION TEXT FOR DEPOSITED TEXT.

NEXT$ (CHAN,BUFFER,KEY,ARRAY,FLAGS,ALTRTN,INDEX,FNO,BUFLEN,KEYLEN)
      NEXT$ IS A MIDAS (MULTIPLE INDEX DATA ACCESS SYSTEM) SUBROUTINE
      USED TO LOCATE A SPECIFIC RECORD BY KEYWORD OR THE NEXT
      RECORD IN THE INDEX.  THE ARGUMENTS ARE:
       CHAN   = SYSTEM CHANNEL NUMBER TO THE DATA FILE.
       BUFFER = AN ARRAY IN MEMORY TO RECEIVE THE RECORD.
       KEY    = KEYWORD TO LOCATE THE RECORD.
       ARRAY  = A 14 WORD ARRAY CONTAINING INDEX AND RECORD POINTERS AND
                ERROR CODE.
       FLAGS  = A 16 BIT WORD USED TO PASS OPTION CONDITIONS TO MIDAS.
       ALTRTN = RETURN TAKEN IF ANY ERROR OCCURES.
       INDEX  = INDEX LEVEL, 0 = PRIMARY, 1-19 FOR SECONDARIES.
       FNO    = FILE NUMBER, ALWAYS = 0.
       BUFLEN = LENGTH OF DATA BUFFER, 0 FOR FULL RECORD.
       KEYLEN = LENGTH OF KEYWORD, 0 FOR FULL KEY, >0 FOR PARTIAL KEY.

PACK (TEXT,LEN)
      PACK IS A SUBROUTINE USED TO REMOVE ILLEGAL FILE NAME CHARACTERS
      FROM A TEXT STRING.  THE ARGUMENTS ARE:
       TEXT   = TEXT STRING.
       LEN    = LENGTH OF STRING.

PAUS (IGO)
      PAUS IS A SUBROUTINE USED TO HOLD THE PROGRAM FLOW UNTIL THE
      OPERATOR PRESSES A TERMINAL KEY.  THE ARGUMENT IS:
       IGO    = RETURNED 0 IF 'Q' OR 'ESCAPE' KEY IS PRESSED, OR 1 FOR
                ANY OTHER KEY.
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PEDIT (CHAN,BUFFER,START,END,ERASE)
      PEDIT IS A SUBROUTINE USED TO PERFORM THE SCREEN EDITING FUNCTION.
      THE ARGUMENTS ARE:
       CHAN   = CHANNEL TO A FORMATTED SCREEN TEMPLATE FILE.
       BUFFER = ARRAY HOLDING ALL THE DATA INPUT OR OUTPUT VIA THE
                TEMPLATE.
       START  = FIRST LINE NUMBER IN TEMPLATE FILE TO BE USED BY PEDIT.
       END    = LAST LINE NUMBER IN TEMPLATE FILE TO BE USED BY PEDIT.
       ERASE  = FLAG TO ERASE SCREEN BEFORE TEMPLATE DISPLAY.

READL (BUFFER,NCHAR,LENB)
      READL IS A SUBROUTINE USED TO GET A LINE OF TEXT FROM THE
      OPERATOR.  THE ARGUMENTS ARE:
       BUFFER = ARRAY TO ACCEPT TEXT.
       NCHAR  = NUMBER OF CHARACTERS ENTERED BY OPERATOR.
       LENB   = LENGTH OF BUFFER.

READN (TEXT,LENG,NUM)
      READN IS A SUBROUTINE USED TO DISPLAY A LINE OF TEXT AND ACCEPT
      A DECIMAL INTEGER (IN ASCII) FROM THE TERMINAL OPERATOR.
      THE ARGUMENTS ARE:
       TEXT   = A LINE OF TEXT TO BE DISPLAYED AS A PROMPT.
       LENG   = THE LENGTH OF THE TEXT IN BYTES.
       NUM    = RETURNED INTEGER ENTERED AT TERMINAL.

RECYCL
      RECYCL IS A PRIME SUPPLIED SUBROUTINE USED TO ALLOW OTHER USERS
      OF THE SYSTEM TO USE YOUR TIME SLICE.

RPTGEN (SPCHN,CHAN,BUFFER,LINES,START,END,FORM)
      PRTGEN IS A SUBROUTINE FROM THE SCREEN EDITING SYSTEM USED TO
      PRODUCE REPORTS.  THE ARGUMENTS ARE:
       SPCHN  = CHANNEL TO A LINE PRINTER SPOOL FILE, IF 0 THEN TO
                THE OPERATOR'S TERMINAL.
       CHAN   = CHANNEL TO THE FORMATTED SCREEN TEMPLATE FILE.
       BUFFER = ARRAY CONTAINING ALL THE DATA FOR THE REPORT.
       LINES  = RETURNED NUMBER OF LINES SENT TO SPOOL FILE.
       START  = FIRST LINE IN TEMPLATE FILE USED IN REPORT.
       END    = LAST LINE IN TEMPLATE FILE USED IN REPORT.
       FORM   = FLAG FOR FORMFEED AT START OF REPORT.

RS (ARG,SHIFT)
      RS IS A PRIME SUPPLIED FUNCTION USED TO SHIFT A SINGLE PRECISION
      INTEGER (16 BITS) TO THE RIGHT (TOWARD LOWER SIGNIFICANCE).
      THE ARGUMENTS ARE:
       ARG    = INTEGER TO BE SHIFTED.
       SHIFT  = NUMBER OF BITS TO SHIFT.

SETERM (TYPE)
      SETERM IS A SUBROUTINE USED TO GET THE OPERATOR'S TERMINAL TYPE
      AND LOAD A COMMON ARRAY WITH CONTROL COMMANDS.  THE ARGUMENT IS:
       TYPE   = RETURNED TYPE CODE FOR TERMINAL.

SPOOL$ (KEY,FILE,FLEN,INFO,BUFFER,BLEN,ERROR)
      SPOOL$ IS A SUBROUTINE SUPPLIED BY PRIME TO PASS A FILE TO THE
      LINE PRINTER SPOOLER.  THE ARGUMENTS ARE:
       KEY    = FLAG FOR SPOOLER MODE, 1 = PRINT.
       FILE   = FILE NAME TO BE PRINTED.
       FLEN   = LENGTH OF FILE NAME.
       INFO   = 12 WORD ARRAY USED TO PASS INFORMATION TO SPOOLER.
       BUFFER = WORKING ARRAY FOR SPOOLER.
       BLEN   = LENGTH OF BUFFER IN WORDS.
       ERROR  = RETURNED ERROR CODE.
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T$MT (UNIT,ADDR,COUNT,COMND,STATUS)
     T$MT IS A PRIME SUPPLIED SUBROUTINE USED TO CONTROL THE MAGNETIC
     TAPE.  THE ARGUMENTS ARE:
      UNIT    = MAGNETIC TAPE DRIVE NUMBER, O RELATIVE.
      ADDR    = MEMORY ADDRESS OF BUFFER FOR RECORD I/O,  FOUR BYTES IF
                IN VIRTUAL MODE.
      COUNT   = NUMBER OF WORDS TO TRANSFER, BETWEEN 0 AND 6000.
      COMND   = COMMAND FLAG FOR ACTION REQUESTED.
      ERROR   = RETURNED ERROR CODE.

T1OU (CHAR)
     T1OU IS A PRIME SUPPLIED SUBROUTINE USED TO OUTPUT ONE CHARCTER
     TO THE OPERATOR'S TERMINAL.  THE ARGUMENT IS:
      CHAR    = THE CHARACTER TO BE OUTPUT, LEFT JUSTIFIED.

TIME$A (BUFFER)
     TIME$A IS A DOUBLE PRECISION REAL FUNCTION SUPPLIED BY PRIME.  IT
     IS USED TO GET THE CURRENT TIME OF DAY.  THE VALUE OF THE FUNCTION
     RETURNED IS EQUAL TO HOURS SINCE MIDNIGHT.  THE ARGUMENT IS:
      BUFFER = RETURNED ASCII VALUE OF TIME IN FORM 'HR:MN:SC', AND
               MUST BE AT LEAST 8 BYTES LONG.

TNOU (TEXT,NCHAR)
     TNOU IS A PRIME SUPPLIED SUBROUTINE USED TO OUTPUT A LINE OF TEXT
     TO THE OPERATOR'S TERMINAL, FOLLOWED BY A CARRIAGE RETURN AND
     LINE FEED.  THE ARGUMENTS ARE:
      TEXT    = TEXT OF OUTPUT MESSAGE.
      NCHAR   = NUMBER OF CHARACTERS IN TEXT.

TNOUA (TEXT,NCHAR)
     TNOUA IS A PRIME SUPPLIED SUBROUTINE USED TO OUTPUT A LINE OF TEXT
     TO THE OPERATOR'S TERMINAL WITHOUT CARRIAGE RETURN AND LINE FEED.
     THE ARGUMENTS ARE:
      TEXT    = TEXT OF OUTPUT MESSAGE.
      NCHAR   = NUMBER OF CHARACTERS IN TEXT.

TONL
     TONL IS A PRIME SUPPLIED SUBROUTINE TO OUTPUT A CARRIAGE RETURN
     AND LINE FEED TO THE OPERATOR'S TERMINAL.

TOOCT (NUM)
     TOOCT IS A PRIME SUPPLIED SUBROUTINE USED TO CONVERT A NUMBER TO
     OCTAL AND DISPLAY AT THE OPERATOR'S TERMINAL.

UNIT$A (CHAN)
     UNIT$A IS A LOGICAL FUNCTION SUPPLIED BY PRIME, USED TO CHECK FOR

     THE USE OF A CHANNEL NUMBER.  THE FUNCTION IS RETURNED TRUE IF THE
     CHANNEL IS IN USE. THE ARGUMENT IS:
      CHAN    = CHANNEL NUMBER TO BE CHECKED.

UPDAT$ (CHAN,BUFFER,KEY,ARRAY,FLAGS,ALTRTN,INDEX,FNO,BUFLEN,KEYLEN)
     UPDAT$ IS A MIDAS (MULTIPLE INDEX DATA ACCESS SYSTEM) SUBROUTINE
     USED TO REWRITE A RECORD PREVIOUSLY FOUND BY LOCK$.
     THE ARGUMENTS ARE:
      CHAN    = SYSTEM CHANNEL NUMBER TO THE DATA FILE.
      BUFFER = AN ARRAY IN MEMORY CONTAINING THE RECORD TO BE UPDATED.
      KEY     = KEYWORD
      ARRAY   = A 14 WORD ARRAY CONTAINING INDEX AND RECORD POINTERS AND
                ERROR CODE.
      FLAGS   = A 16 BIT WORD USED TO PASS OPTION CONDITIONS TO MIDAS.
      ALTRTN = RETURN TAKEN IF ANY ERROR OCCURES.
      INDEX   = INDEX LEVEL, 0 = PRIMARY, 1-19 FOR SECONDARIES.
      FNO     = FILE NUMBER, ALWAYS = 0
      BUFLEN = LENGTH OF DATA BUFFER, MUST BE 0
      KEYLEN = LENGTH OF KEYWORD, MUST BE 0
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VOPEN$ (FILE,FLEN,MODE,CHAN,ERROR)
      VOPEN$ IS A SUBROUTINE USED TO OPEN A FILE ON AN AVAILABLE
      CHANNEL (SUPPLIED BY THE SYSTEM).  THE ARGUMENTS ARE:
       FILE   = FILE NAME TO BE OPENED.
       FLEN   = LENGTH OF FILE NAME.
       MODE   = READ/WRITE FLAG.
       CHAN   = RETURNED CHANNEL FOR OPENED FILE.
       ERROR  = RETURNED ERROR CODE.

WTLIN$ (CHAN,BUFFER,COUNT,ERROR)
      WTLIN$ IS A PRIME SUPPLIED SUBROUTINE USED TO WRITE AN ASCII
      STRING TO A FILE.  THE ARGUMENTS ARE:
       CHAN   = FILE CHANNEL NUMBER.
       BUFFER = ARRAY CONTAINING THE STRING TO BE WRITTEN.
       COUNT  = NUMBER OF 16 BIT WORDS IN BUFFER.
       ERROR  = RETURNED ERROR CODE.

YSNO$A (TEXT,LEN,KEY)
      YSNO$A IS A LOGICAL FUNCTION SUPPLIED BY PRIME USED TO DISPLAY A
      MESSAGE AND RECEIVE A YES OR NO FROM THE OPERATOR.  THE FUNCTION
      IS RETURNED TRUE FOR A YES RESPONSE.  THE ARGUMENTS ARE:
       TEXT   = MESSAGE USED AS A PROMPT, A '? ' IS APPENDED.
       LEN    = LENGTH OF MESSAGE IN BYTES.
       KEY    = DEFAULT KEY

ZFIL (BUFFER,LENB,CHAR)
      ZFIL IS A PRIME SUPPLIED SUBROUTINE USED TO FILL AN ARRAY WITH
      A SPECIFIC CHARACTER.  ZFIL RUNS IN VIRTUAL MODE ONLY.
      THE ARGUMENTS ARE:
       BUFFER = ARRAY TO BE FILLED.
       LENB   = LENGTH OF BUFFER IN BYTES.
       CHAR   = CHARACTER FOR FILLING, LEFT JUSTIFIED.

ZMV (TEXTS,LENS,TEXTD,LEND)
      ZMV IS A PRIME SUPPLIED SUBROUTINE USED TO MOVE A TEXT STRING FROM
      ONE ARRAY TO ANOTHER, TRUNCATING OR BLANK PADDING. ZMV RUNS IN
      VIRTUAL MODE ONLY.  THE ARGUMENTS ARE:
       TEXTS  = SOURCE TEXT.
       LENS   = LENGTH OF SOURCE STRING.
       TEXTD  = DESTINATION TEXT.
       LEND   = LENGTH OF DESTINATION STRING.

ZMVD (TEXTS,TEXTD,LEN)
      ZMVD IS A PRIME SUPPLIED SUBROUTINE USED TO MOVE TEXT FROM ONE
      ARRAY TO ANOTHER.  THE ARRAYS ARE ASSUMED TO BE OF EQUAL SIZE.
      ZMVD RUNS IN VIRTUAL MODE ONLY.  THE ARGUMENTS ARE:
       TEXTS  = SOURCE TEXT STRING.
       TEXTD  = DESTINATION ARRAY.
       LEN    = LENGTH OF STRING IN BYTES.
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END

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